

The University of Chicago

THE PHYSIOLOGY OF FRENCH
CONSONANT CHANGES
A STUDY IN EXPERIMENTAL PHONETICS

A DISSERTATION SUBMITTED TO THE FACULTY
OF THE DIVISION OF THE HUMANITIES IN
CANDIDACY FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY

DEPARTMENT OF ROMANCE LANGUAGES
AND LITERATURE

1936

By
ERNEST FABER HADEN

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprint of LANGUAGE DISSERTATION No. 26, 1938
LINGUISTIC SOCIETY OF AMERICA
University of Pennsylvania, Philadelphia



Digitized by the Internet Archive
in 2026

The University of Chicago

THE PHYSIOLOGY OF FRENCH
CONSONANT CHANGES
A STUDY IN EXPERIMENTAL PHONETICS

A DISSERTATION SUBMITTED TO THE FACULTY
OF THE DIVISION OF THE HUMANITIES IN
CANDIDACY FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY

DEPARTMENT OF ROMANCE LANGUAGES
AND LITERATURE

1936

By
ERNEST FABER HADEN

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprint of LANGUAGE DISSERTATION No. 26, 1938
LINGUISTIC SOCIETY OF AMERICA
University of Pennsylvania, Philadelphia



PREFACE

The idea that modern articulations have some explanatory value for the history of a language is not a new one. L'Abbé Rousselot in his *Principes de phonétique expérimentale* (1897-1908)¹ made no less than eight direct applications of his findings to the history of French sounds.

A more recent work, Bauche's *Le Langage populaire*,² contained a large number of examples of modern articulatory phenomena which correspond exactly to phenomena postulated or recorded in the history of French: [g] between front vowels pronounced somewhat like [j]; the pronunciation *cintième* [sɛtjem] for *cinquième*; the insertion of a transition sound [t] between contiguous [s] and [r].

Late in 1933 a new text book on the history of the French language³ presented tracings of seventeen radiographs of consonant and vowel articulations of Modern French (and of one sound borrowed from Czech) as examples of certain Latin sounds from which other sounds evolved into French.

Implicit in these books is the theory that, considered as purely physiological phenomena, modern articulations in French reflect tendencies which have characterized the language at an earlier date, if not throughout its history. Of the three types of factors, namely physiological, psychological, and physical, this study deals with the first category only. For it is in this province alone that the theory stated above is defensible.

Changes of a physiological nature are, for the most part, combinative changes. And this is particularly true of consonants. It is in certain combinations with certain vowels or other consonants, that consonantal changes are effected. This study deals therefore with consonantal

¹ Abbé J. Rousselot, *Principes de phonétique expérimentale* 617, 618, 685, 729, 859, 977, 985, 989 (nouvelle édition, Paris, 1924).

² Henri Bauche, *Le Langage populaire: Grammaire, Syntaxe et Dictionnaire du français tel qu'on le parle dans le peuple de Paris, avec les termes d'argot usuel* 50, 55-56, et passim (Paris; Payot, 1928).

³ F. Brunot et Ch. Bruneau, *Précis de grammaire historique de la langue française* (Paris: Masson, 1933).

changes. Its aim is to present graphically by means of radiograph and palatogram, articulations of consonants in combinations similar to those found in spoken Latin, and in subsequent stages of the development of French. An attempt is made to explain, on the basis of these findings, the manner in which the changes took place.

These consonantal changes fall into three groups: (a) the fronting of back consonants; (b) the effect of [j] on front consonants; (c) the loss of consonants.

Only two subjects were used in this study, one for the investigation by X-ray, the other for palatograms. Although this small number of subjects may be considered insufficient to establish the validity of an individual articulation, it seems probable that the validity of the method is not impaired.

I take pleasure in acknowledging my indebtedness to the following members of the Department of Romance Languages of the University of Chicago:

To Professor C. E. Parmenter, whose keen criticism and helpful guidance proved invaluable. To his teaching and example I owe much. The radiographing incident to this study was made possible through funds administered by him in the Phonetics Laboratory.

To Professor Hayward Keniston, in whose course in Romance linguistics this study was conceived, and who lent encouragement and aid through the interest which he showed in this work.

To Mr. S. N. Treviño, who generously gave time, help, and advice in the conduct of the experiments.

I am also indebted, of course, to a great number of scholars in the field of linguistics, without whose works this study would have been impossible, especially those mentioned in the selective bibliography included in this dissertation. For the shortcomings of this work, however, I alone am responsible.

TABLE OF CONTENTS

SYMBOLS USED FOR TRANSCRIPTION.....	7
Diagram of Vowel Positions	
Descriptive Table of Consonant Sounds	
Diagram of Regions of Articulation	
INDEX OF FIGURES AND SOUNDS.....	12
CHAPTER I. INTRODUCTION.....	15
The Consonant and the Syllable: Voice; Articulation; Zone of articulation; Manner of articulation; Tension; The consonant in the syllable.....	15
The Syllable: Releasing and arresting consonants, in stressed and unstressed syllables; Initial consonants in Latin; The releasing consonant intervocalic; Assimilation and accord; The releasing consonant-group.....	18
Summary of consonant changes.....	23
CHAPTER II. THE INVESTIGATION.....	25
The Problem.....	25
Subject A: Methods of investigation; Linguistic material used; Procedure adopted for this investigation; Graphic presentation of radiographs.....	25
Subject B: The artificial palate; Linguistic material used; Procedure adopted for investigation with the artificial palate; Photographing the palatogram; Tracing the palatogram; Method of showing longitudinal and latitudinal depth of the palate, in conjunction with the palatogram; Photographic prints of sample palatograms.....	27
CHAPTER III. THE FRONTING OF BACK CONSONANTS.....	33
Back Consonants in Strong Position.....	34
[k] in strong position followed by [i, e, ε], [a]....	34
[g] in strong position followed by [i, e, ε, a].....	44

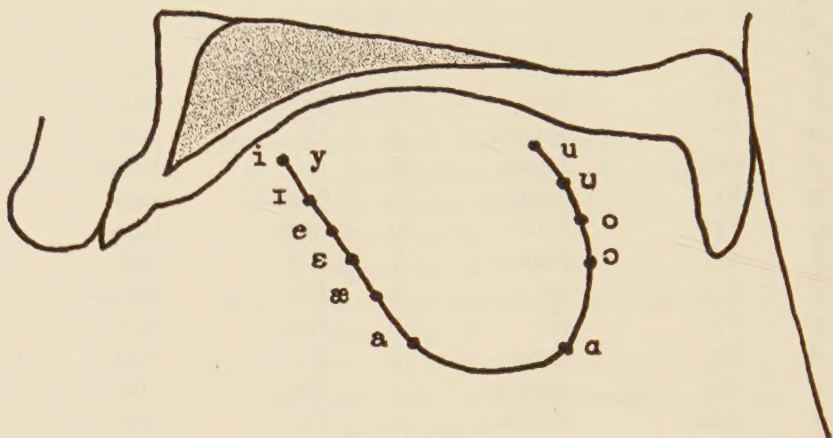
Back Consonants between Vowels	49
[k] intervocalic followed by [i, e, ε]	49
[g] intervocalic followed by [i, e, ε]	52
[k, g] intervocalic followed by [a] and preceded by a front vowel: [i, e, ε, a]	56
[kw] and [gw]	57
[k, g] followed by [j]	58
Back Consonants in Weak Position	61
[k, g] in weak position followed by [t, d]	61
[k] in weak position followed by [s]	64
[k, g] followed by [r]	66
[k, g] followed by [n]	68
Back Consonants in Releasing Consonant Group	72
[k, g] followed by [l]	72
CHAPTER IV. THE INFLUENCE OF [j] OTHER THAN FRONTING	75
Dental Consonants in Strong Position: [tj] and [dj] in strong position	75
Dental Consonants between Vowels: [tj] inter- vocalic; [dj] intervocalic	79
[n] influenced by [j]	80
[l] influenced by [j]	84
[s] and [z] influenced by [j]	88
Labial Consonants: [p] and [b] influenced by [j]	88
CHAPTER V. THE LOSS OF CONSONANTS	92
Occlusives	92
Between vowels:	92
1. [k, g] intervocalic	92
2. [t, d] intervocalic	98
3. [p, b] in contact with labialized vowels [u, o, ɔ]	98
In final position	103
1. [k] final	103
2. [t], [d] final	104
3. [p], [b] final	104
Constrictives: In weak position, final of word or of syllable	106
CHAPTER VI. CONCLUSION	110
APPENDIX A	112
APPENDIX B	113
BIBLIOGRAPHY	114

SYMBOLS USED FOR TRANSCRIPTION

Symbol	Example	Symbol	Example
p	Fr. <i>patte</i>	g̃	Fam. Par. <i>gui</i>
b	Fr. <i>bas</i>	k	Fr. <i>cou</i>
m	Fr. <i>masse</i>	g	Fr. <i>goût</i>
β	Span. <i>huevo</i>	ŋ	It. <i>lungo</i>
w	Fr. <i>ouate</i>	x	Span. <i>caja</i>
ɥ	Fr. <i>lui</i>	g	Span. <i>haga</i>
f	Fr. <i>femme</i>	l̥	Am. <i>ball</i>
v	Fr. <i>va</i>	ʀ	Fr. <i>garage</i> ³
t	Fr. <i>tas</i>	h	Eng. <i>hat</i>
d	Fr. <i>dame</i>	i	Fr. <i>fini</i>
n	Fr. <i>ananas</i>	ɪ	Eng. <i>fish</i>
θ	Span. <i>acerca</i>	e	Fr. <i>pré</i>
ð	Span. <i>amado</i>	ɛ	Fr. <i>paix</i>
s	Fr. <i>sa</i>	æ	Fam. Par. ² <i>tu parles!</i>
z	Fr. <i>oiseau</i>	a	Fr. <i>patte</i>
ts ¹	It. <i>zio</i>	ɑ	Fr. <i>pas</i>
dz	It. <i>mezzo</i>	ɔ	Fr. <i>poche</i>
r	Span. <i>pero</i>	o	Fr. <i>peau</i>
l	Fr. <i>alla</i>	ʊ	Eng. <i>push</i>
ɹ	Am. <i>rat</i>	u	Fr. <i>poule</i>
ʃ	Fr. <i>achat</i>	y	Fr. <i>pu</i>
ʒ	Fr. <i>déjà</i>	ø	Fr. <i>peu</i>
c	It. <i>ci, ciò</i>	ə	Fr. <i>le</i>
ʝ	It. <i>Parigi,</i> <i>Perugia</i>	œ	Fr. <i>seul</i>
ʎ	It. <i>meglio</i>	ê	Fr. <i>pain</i>
ɲ	Fr. <i>agneau</i>	ã	Fr. <i>banc</i>
ç	Germ. <i>ich</i>	œ̃	Fr. <i>un</i>
j	Fr. <i>bouilli, paya</i>	õ	Fr. <i>bon</i>
t̥	(midpalatal t)	:	signifies that the preceding sound is long
d̥	(midpalatal d)	'	is placed before a stressed syllable
k̃	Fam. Par. ² <i>qui</i>		

¹ Ligatured *ts* and *dz* are not used, as a matter of typographical convenience.² Familiar Parisian.³ With uvular vibration.

DIAGRAM OF VOWEL-POSITIONS
actual size



VOWELS

	Symbol	Examples	
		French	English
Front slit	ɪ	fini	fish
	ɪ		
	e	pré	
	ε	paix	pat
	æ		
	a	patte	
Front rounded	y	pu	
	ø	peu	
	ə	le	
	œ	seul	
Back rounded	u	poule	push
	ʊ		
	o	peau	
	ɔ	poche	
	ɑ	passe	

DESCRIPTIVE TABLE OF CONSONANT SOUNDS

The following departures have been made from the alphabet of the International Phonetic Association: , under *t* and *d* is used to show palatalized *t*, *d*; ⁻ is used over *k*, *g* to show fronted contact; *ɣ* is used instead of *ɣ*.

Symbol	Voice	Zone (active) (passive)	Manner ¹	Ten- sion
p	voiceless	bilabial	occlusive	tense
b	voiced	bilabial	occlusive	lax
m	voiced	bilabial	occlusive nasal	tense
β	voiced	bilabial	constrictive	lax
w	voiced	bilabio-velar	constrictive semi-consonant	lax
ɥ	voiced	bilabio-palatal	constrictive semi-consonant	lax
f	voiceless	labio-dental	constrictive	tense
v	voiced	labio-dental	constrictive	lax
θ	voiceless	apico-(inter)dental	constrictive	tense
ð	voiced	apico-(inter)dental	constrictive	lax
t	voiceless	predorso-dental	occlusive	tense
d	voiced	predorso-dental	occlusive	lax
n	voiced	predorso-dental	occlusive nasal	tense
ts	voiceless	predorso-dentigingival	occlusive-constrictive	tense
dz	voiced	predorso-dentigingival	occlusive-constrictive	lax
r	voiced	apico-gingival	constrictive vibrant	lax
l	voiced	predorso-gingival	constrictive lateral-open	lax
s	voiceless	predorso-gingival	constrictive	tense
z	voiced	predorso-gingival	constrictive	lax
ʃ	voiced	apico-gingival	constrictive fricative	lax
f	voiceless	predorso-prepalatal	constrictive bilabial	tense
ɸ	voiced	predorso-prepalatal	constrictive bilabial	lax
c (tʃ)	voiceless	predorso-prepalatal	occlusive-constrictive	tense
ɟ (dʒ)	voiced	predorso-prepalatal	occlusive-constrictive	lax

For definitions of terms, see Chapter I.

¹The first term in this column refers to a physiologic characteristic; others designate additional essential characteristics.

DESCRIPTIVE TABLE OF CONSONANT SOUNDS—*Concluded*

Symbol	Voice	Zone (active) (passive)	Manner	Ten- sion
ɬ	voiced	middorso-midpalatal	constrictive lateral- open median re- lease ²	lax
ɲ	voiced	middorso-midpalatal	occlusive-constrictive nasal	tense
ç	voiceless	middorso-midpalatal	constrictive	tense
j	voiced	middorso-midpalatal	constrictive semi- consonant	lax
t	voiceless	middorso-midpalatal	occlusive-constrictive	tense
d	voiced	middorso-midpalatal	occlusive-constrictive	lax
k̄	voiceless	postdorso-postpalatal	occlusive-constrictive	tense
ḡ	voiced	postdorso-postpalatal	occlusive-constrictive	lax
k	voiceless	postdorso-velar	occlusive	tense
g	voiced	postdorso-velar	occlusive	lax
ŋ	voiced	postdorso-velar	occlusive nasal	tense
x	voiceless	postdorso-velar	constrictive	tense
q	voiced	postdorso-velar	constrictive	lax
ɭ	voiced	postdorso-velar	constrictive lateral open	lax
ʀ	voiced	uvular-postdorsal	constrictive vibrant	lax
h	voiceless	glottal	constrictive	tense

² In releasing the position for this type of consonant, the tongue moves away from the palate along the median line, the sides of the tongue continuing contact with the palate.

DIAGRAM OF REGIONS OF ARTICULATION



- | | |
|----------------|----------------|
| I. apical | 1. dental |
| II. predorsal | 2. gingival |
| III. middorsal | 3. prepalatal |
| IV. postdorsal | 4. midpalatal |
| | 5. postpalatal |
| | 6. velar |
| | 7. uvular |

INDEX OF FIGURES AND SOUNDS

Vowel Sounds

	Figure
[i] Palatogram.....	10
Radiograph.....	7, 9, 27, 36, 44, 45, 115
[e] Palatogram.....	11
Radiograph.....	44
[ɛ] Palatogram.....	12
Radiograph.....	20, 45
[æ] Radiograph.....	20
[a] Radiograph.....	37, 45, 121, 122
[ɔ] Radiograph.....	120
[u] Radiograph.....	8, 120, 121, 122

Consonant Sounds

[p] Radiograph.....	8, 129, (lips only) 130
[b] Radiograph.....	7, 115, 130
[t] Radiograph.....	23, 57, 125, 126
Palatogram.....	85, 124, 128
[d] Radiograph.....	62, 126
Palatogram.....	91, 92, 124, 128, 134
[tj] Palatogram.....	58, 84-90
[ts] Palatogram.....	22
[tʃ] Palatogram.....	19
[kt] Palatogram.....	56-60
[dj] Palatogram.....	30, 31, 92-95
[dʒ] Palatogram.....	31-33
[gd] Palatogram.....	61-64
[k] Radiograph.....	9, 26, 40, 49, 116, 118, 120, 121
Palatogram (<i>k</i> -initial).....	3, 13, 14, (Subject X) 15, 38, 53
(- <i>k</i> - intervocalic).....	1, 2, 25, 38, 39, 46, 47, 55, 57, 65, 117
(- <i>k</i> final).....	59, 75, 132, 133
[kj] Palatogram.....	53
[kw] Palatogram.....	51, 52

[kn]	Palatogram.....	73
[kr]	Palatogram.....	68
[ks]	Palatogram.....	65-67
[kt]	Palatogram.....	57-60
[kl]	Palatogram.....	81
[lk]	Palatogram.....	109
	Radiograph....	26, 27, 49, 50, 118, 122
[g]	Palatogram: <i>g</i> - initial.....	28-30, 54
	- <i>g</i> - intervocalic.....	24, 25, 42, 47, 119
	- <i>g</i> final.....	63, 71, 72, 76, 133
[gj]	Palatogram.....	54
[gn]	Palatogram.....	74
[gɹ]	Palatogram.....	69
[gl]	Palatogram.....	82
[gd]	Palatogram.....	63, 64
	Occlusive-constrictive	
[t]	Palatogram (Subject X).....	16-18
[c]	Palatogram (Subject X).....	18, 21
[ts]	Palatogram (Subject X).....	21
	Constrictive	
[s]	Radiograph.....	23, 41, 114
	Palatogram (Subject X).....	21
	(Subject B).....	22, 65, 90, 111
[sj]	Palatogram.....	67, 112
[ks]	Palatogram.....	66, 67
[z]	Radiograph.....	41
[zj]	Palatogram.....	113
[ʃ]	Palatogram.....	19, 66
[ʒ]	Radiograph.....	27, 36
	Palatogram.....	33-35, 94
[dʒ]	Palatogram.....	31, 32
[g]	Palatogram (Subject X).....	123
[n]	Radiograph.....	99
	Palatogram.....	52, 97, 98, 101
[nj]	Radiograph.....	99, 103
	Palatogram.....	100-102
[ɲ]	Radiograph.....	78-80, 103
	Palatogram.....	75-77, 104
[l]	Radiograph.....	106, 110
	Palatogram.....	105

[lj]	Palatogram.....	107
[ɬ]	Palatogram (Subject X).....	83, 108
[r:]	Palatogram (Subject X).....	70
[j]	Radiograph (derived from palatogram).....	23, 40, 50
	Palatogram.....	
	43, 48, 60, 64, 67, 71, 72, (Subject X) 83, 86-89, 95, 96, 98, 108	
	Graph showing depth of palate.....	4
	Sample photographic prints of palatograms.....	5, 6

CHAPTER I. INTRODUCTION

THE CONSONANT AND THE SYLLABLE

VOICE.—The vocal cords, when brought together in a more or less horizontal plane, may close the trachea completely, thus preventing the escape of air (glottal stop), or, if the closure is not quite complete, they offer resistance to the escaping air, and themselves vibrate along their edges as the air is forced out between them. This vibration propagated by the air-column is termed voice. The absence of vibration, due to the ease of escape of the air, the vocal cords being retracted to either side, in any articulation of a consonant, determines that consonant as voiceless.

ARTICULATION.—The production of a consonant calls for the displacement of an active organ, making a complete or partial obstruction by means of contact with a passive organ, or another active organ. The active organs of articulation are: the lower jaw, the lips, the tongue, the uvula, and the velum as secondarily involved in nasal articulations; the passive organs, the teeth, hard and soft palate.

ZONE OF ARTICULATION.—The most important active organ is the tongue, which can make contact with several different regions of its surface against several different regions of the 'passive organ' (the palate). The tongue's surface is divided into: apical region (apex, tip); predorsal, middorsal, postdorsal regions. The palate is divided similarly into: dental, gingival or alveolar, prepalatal, midpalatal, postpalatal, velar, and uvular zones. These regions are termed zones of articulation, rather than points of articulation. The zones of articulation of both active and passive organs are mentioned (see tables, pp. 9-11). Thus [s] in French has a predorsal-dentigingival zone of articulation.

MANNER OF ARTICULATION.—This term is used to designate the nature of the obstruction: first the physiologic aspect of the articulation, then any additional characteristics which may be significant.

If the obstruction is complete, the consonant is occlusive; if only partial obstruction is made, the sound is constrictive, resulting in audible friction; if there is a combination in a single articulation of occlusion with constriction (the consonant is usually characterized by

median release of the position) the sound is called occlusive-constrictive; if the active organ vibrates (e.g. tongue-tip or uvula), the sound is a constrictive vibrant; a constrictive in the production of which the air escapes around the sides of the tongue, is termed constrictive lateral-open; when the obstruction in the mouth is accompanied by nasal resonance, the air being allowed to escape through the nose, the sound is (occlusive or constrictive) nasal. The term nasal refers then to a physical property, a quality, as well as to a physiological characteristic.

TENSION.—Rousselot¹ found that in French (Parisian speech) the muscular tenseness of the active organ is relatively greater in the voiceless articulation than in the corresponding voiced articulation, e.g. [t] tense, [d] lax. The terms 'tense' and 'lax' are therefore purely relative. It is evident that a constrictive fricative resulting from the relaxing of tenseness of a voiced (lax) occlusive, is more lax than the voiced occlusive, [ð] in OFr. *desfider* [desfiðer] < Latin *disfidare* [disfidare]. Such secondary developments are designated as relaxed. The series is [t] (tense), [d] (lax), [ð] (relaxed).

THE CONSONANT IN THE SYLLABLE.—The consonants of Latin develop according to their position in the syllable. This brings up the question of syllable division.

En français les syllabes ouvertes dominant. Quand une consonne se trouve entre deux voyelles, elle appartient à la deuxième: a-mi, ca-deau; souvent même deux consonnes sont réunies à la voyelle qui suit, quand la deuxième est [l], [j], [w], [ɥ]: ta-bleau. La division des mots ne change rien à la division en syllabes: que-lhomme, u-narme.²

Presumably the phonetic syllabification in Latin was the same, since the other Romance languages resemble French in this respect.

The question immediately presents itself: in what way does a consonant 'belong' to a syllable? The dividing of sounds from one another in kymograph and oscillograph tracings is extremely difficult, and lacks accuracy unless there is a regular alternation of voiced and voiceless sounds. The division of syllables is even more difficult, because such tracings show no breaks, no sure limits for syllables.

If, however, the intervocalic consonant [k] in the words [miku],

¹ Abbé J. Rousselot, *Principes de phonétique expérimentale* 1.591 (nouvelle éd., Paris, 1924).

² Paul Passy, *Petite Phonétique comparée* . . . 45 (Leipzig-Berlin, 1912). There is no mention made here of groups like [kr] and [gr], but see pp. 66-8 below.

[aku], [boku], followed in each case by [u], showed great similarity of place of articulation, as compared with the articulation of [k] in the series [boku], [buka], [puki] in which it is preceded by [u] or [o] in each case, then the consonant could be said to 'belong' to the syllable which contained the vowel of greatest influence in affecting the consonant articulation. Such influence if it were to be found would be clearly shown in palatograms.

A series of palatograms was made therefore of the two sets of words. Figures 1 and 2 respectively show polygrams of these palatograms. In Figure 1 it will be noted that the closure for [k] cuts across the median line in three places, farthest back when a back vowel also precedes the

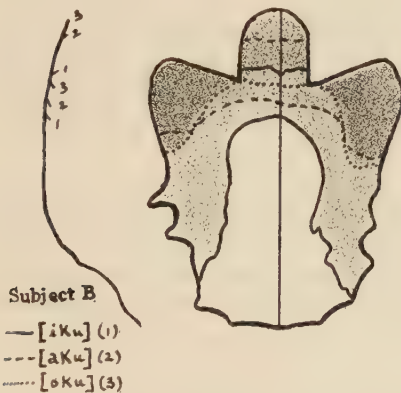


Fig. 1

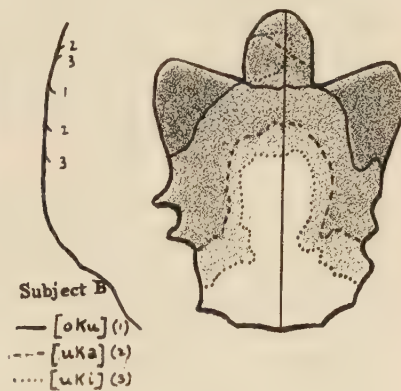


Fig. 2

The line to the left of the palatogram is a profile outline of the median line of the palate. The contact is considered significant only across the median line, thus leaving out of account the marking which might be part of the vowel articulation.

consonant, somewhat farther forward when the consonant is preceded by [a], still a little farther forward, when preceded by [i]. The vowel which precedes [k] is not entirely without influence upon it. But the divergence on the tracing (that is, the distance between the points where ku and ki cross the median) is only 6.5 mm. In Figure 2, on the other hand, the points at which the [k] closure cuts across the median are more spread out: there is as great a distance between [k + u] and [k + a] on the median line, as the total divergence in the other polygram, and between [k + a] and [k + i] a little over 7 mm. There is then greater accord³ between the consonant and the following vowel, than between

³ For a definition of this term see note 12 of this Chapter.

the consonant and the preceding vowel. The single intervocalic consonant can therefore properly be said to 'belong' to the second syllable, i.e. with the vowel which follows it.

THE SYLLABLE

Before examining the various positions of consonants in the syllable, in relation to their function as part of the syllable, and in relation to their consequent development, it will be necessary to give a working definition of the syllable.

'The fundamental unit for phonetic analysis,' says R. H. Stetson,⁴ is the movement of the syllable, a single breath pulse which is sometimes released by a consonant movement and sometimes arrested by a consonant movement. . . . The delimiting consonants are integral parts of the chest pulse; they either release or arrest the chest pulse; the vowel on the other hand is an articulatory movement accompanying the chest pulse.⁵

The syllable is constituted by a ballistic movement of the expiratory muscles. . . . The consonants are not mere noises floating in the stream of sound. They are accessory movements, connected by the compressed air column with the chest muscles, and they have a function in releasing and arresting the chest pulse which constitutes the main movement of the syllable.⁶

The consonants are to be divided into releasing consonants which start the syllable movement and arresting consonants which stop the syllable movement.⁷

To exemplify what is meant by a ballistic movement, Professor Stetson says:

When a tennis stroke is made, a sudden contraction of the extensors of the arm starts the stroke; the extensors immediately relax, during the first quarter of the excursion, and the arm and racket are carried through the stroke by their momentum; at the close of the stroke the flexors of the arm come into play and arrest the arm. All rapid

⁴ R. H. Stetson, *Motor Phonetics*; in *Archives néerlandaises de phonétique expérimentale*, Vol. III (la Haye, 1928).

⁵ *Ibid.* 21.

⁶ *Ibid.* 29.

⁷ *Ibid.* 43.

movements are of this type. In speech the rapid movements of articulation, and of the syllable pulse, are ballistic.⁸

What Passy says may be translated into Stetson's terms thus: single consonants (and in addition, consonant groups the second of which is [l], [j], [w] or [ɥ]) between vowels are releasing consonants or releasing groups.⁹

RELEASING AND ARRESTING CONSONANTS, IN STRESSED AND UNSTRESSED SYLLABLES.—Now the ballistic movement which constitutes the syllable is performed by the contraction of the muscles of the chest and diaphragm (comparable to the extensors in the example quoted from Stetson). This contraction increases the air pressure in the expiratory tract. The consonant occurring at the beginning of this movement is forcefully articulated, and presents an obstruction to greater pressure. Thereafter the momentum of the movement which is carried on by the escaping air expends itself during the vowel, or during the vowel + consonant of the rest of the syllable. If we take the example of *faisons* [fə-zō] the first syllable [fə] is a single breath pulse resulting from a sudden contraction of the expiratory muscles; the position of lips and teeth for [f] is assumed just before the pulse. To withstand the relatively great air-pressure at this point, the consonant constriction must be relatively tense. The momentum of the ballistic movement is taken up during the articulation of [ə]; the whole process is then repeated for [zō]. These two releasing consonants are said to be in strong position; they are initial of syllables.

In Latin *factum* [faktum], the syllables here are composed of releasing consonant + vowel + arresting consonant. This arresting consonant performs the function of stopping the expiratory movement. Since the arresting consonant comes at the end of the pulse, when the momentum is all but spent, it is relatively less forcefully articulated than the initial (releasing) consonant. It is said to be in weak position. In this word [faktum] there are then two releasing consonants (in strong position) [f] and [t], and two arresting consonants (in weak position) [k] and [m]. But the two syllables are not equal in tension because of the stress on the first. The chest pulse for the stressed syllable is produced by a more energetic contraction of the expiratory muscles than the unstressed syllable. The arresting consonant of the weaker (unstressed) syllable will necessarily be weaker than the arresting consonant of the stressed

⁸ Ibid. 27.

⁹ Cf. note 2 of this chapter.

syllable. Thus it is not surprising that already in Imperial times, the [m] had ceased to be pronounced; the weakest articulation of the word is the first to disappear. The other weak consonant [k] (arresting the stressed syllable) remains longer than [m], but is modified relatively early.

Of the two releasing consonants [f] and [t], the initial of the word is more stable than the other. In fact, [f] is the only consonant in this word which has come down unchanged from the Latin form: [faktum] > [fɛ]. But the [t], although it becomes silent after becoming final (arresting, therefore weak), is preserved much longer than the arresting consonants [k] and [m]. The noun form of the French word *un fait* [œ fet] has the pronunciation of the final due to a restoration, influenced by spelling, in order to differentiate it from the past participle [fɛ].¹⁰

The four consonants of the word *factum* then disappear or are modified in the following order:

[m] in weak position, arresting consonant of weak syllable disappears earliest;

[k] in weak position, arresting consonant of strong syllable, is modified, then absorbed into the vowel;

[t] remains until, having become final, it is in weak position of the newly made monosyllabic word and then drops;

[f] remains unchanged.

[faktu] > [façtə] > [fajt] > [fet] > [fɛ]

INITIAL CONSONANTS IN LATIN.—In the development of Latin initial consonants into French there is displayed an extreme degree of stability: none is lost while it is initial, and only three are modified. This situation finds its parallel in the pronunciation of initial r [r:] in Spanish and Portuguese.

One of the apparent exceptions to the stability of Latin initials is the loss of the so-called 's impure'. The consonant s + occlusive in initial position disappeared only after it had become final of syllable, because of the prothesis of [e]: ['skɔlə] > [es'kɔlə] > [ekɔlə(ə)]. Strictly speaking, it is the loss not of an initial but of an arresting (weak) consonant.

The three Latin initial consonants which are modified¹¹ are: (1)

¹⁰ Abbé G. Voile, *Les Origines des complications orthographiques*, in *Le français moderne* 2.1.58 (Jan. 1934); quoting from Th. Joran, *Péril de la syntaxe et la crise de l'orthographe* 138 (Paris: A. Savaète): 'Faites sonner le t final dans *fait* (substantif); *fait* prononcé *fai*, représente le participe passé du verbe faire. ...' This is, of course, an artificial rule, just as [fet] is an artificial pronunciation.

¹¹ The pronunciation of r in all positions is [ʀ], which seems to have arisen in Paris, because of social rather than physiologic circumstances, and is spreading

consonantal *i* [j] far from being relaxed, in Vulgar Latin is pronounced [d] or perhaps [j]. This is essentially a change in intensity: the semi-consonant [j] is a constrictive whose articulation may be quite lax, as in English *yes*, *yacht* or more tense, though still a fairly open constriction as in French *yeux*, *hier* [jɛ:r] (but not in the careful pronunciation [iɛ:r]). At the stage of [j] < Latin [j], the sound falls in with the fronted Latin [g] and later undergoes the same modifications as it (see (2) below).

(2) Latin [g + i, e, ε, a] is fronted by assimilation in position to the front vowels, and in the process changes from occlusive to constrictive (see p. 44 below).

(3) Latin [k] before the front vowels [i, e, ε, a] is similarly fronted and becomes constrictive (see pp. 34-43 below).

THE RELEASING CONSONANT INTERVOCALIC.—The word ['faktum] furnished examples of two releasing and two arresting consonants. Among releasing consonants, the initial of word, and the initial of syllable following another consonant, are most stable.

The releasing consonant after a vowel (a single intervocalic consonant) presents a slightly different situation from the releasing consonants already examined. In the Latin word [fatam] > [fe], [t] is a releasing consonant intervocalic. Because of the operation of inertia, however, the consonant undergoes several changes. The intervocalic [t] constitutes a period of silence (voiceless) between two voiced elements, as in the It. *fata* [fata]. If the voice vibration is continued throughout this articulation (laryngeal inertia), [t] becomes [d] as in OProv. *fada* ['fada]. When the articulatory energy is divided between a contraction of the glottis (vocal cords) on the one hand and a tongue activity on the other, it is found that the energy of the tongue movement, as expressed in tenseness of articulation, is less great than is the case for the voiceless counterpart. The passing of [t] to [d] initiated perhaps by laryngeal inertia, is accompanied by a certain tongue inertia. The tongue, which is lower for any vowel than it is for a lingual consonant, might be said also to be 'lower' for [d] than for [t], inasmuch as it does not press against the palate with the force used in the articulation of [t].

From the lax articulation of [d], tongue inertia brings about a relaxed sound [ð]. The tongue, low for the vowel preceding the consonant,

throughout the whole of France. It is curious to find that in other Romance territory (Spanish-speaking Puerto Rico, parts of Portugal) there is a tendency to make the same substitution of [r] for [r] as took place in France.

anticipating also a low position for the vowel following the consonant, fails to rise for a forceful closure [d], but makes a narrowed passage for the escaping air, a constrictive fricative. This stage is represented by the Spanish *hada* ['aða]. Further operation of tongue-inertia brings the word to the stage of 17th century French *fée* ['feə]; the consonant closure, relaxed as it was, has disappeared completely (cf. the Modern Spanish *amado* [a 'mao]). The modern stage of the word [fe:] or [fej] is found in French Switzerland, but Paris has [fe].

ASSIMILATION AND ACCORD.—Assimilation is the process by which a sound influences a contiguous or neighboring sound and which results in a change in voice, in manner, in position, or in any combination of the three. For 'reciprocal assimilation' the term *accord*¹² seems preferable.

THE RELEASING CONSONANT-GROUP.—The consonant group [kt] in *factum* differs from a consonant group like [kj] in *faciam* > *face*, *fasse*, for instance. In the former word, the [kt] are abutting, arresting and releasing consonants; in the latter [kj] form a releasing consonant-group, and the consequent development is different.¹³ The voicelessness of the strong [k] spreads to the other member of the group [j], but [j] pulls the articulation-zone of [k] forward. When followed by the front vowels [i, e, ε, a], the Latin consonants [k] and [g] are fronted, and eventually become respectively [s, ʃ] and [ʒ]. But they remain intact before other vowels, even before [u], which gives [y]. This is in Modern French a front vowel, but evidently was fronted from its original position (Latin [u:]) fairly late, otherwise the back consonants would have been fronted by it as they were by [i]. We should then have had Latin *culum* ['ku:lu] > [*sy], not [ky] *cul*, as is the case. It is to be noted that the fronting of the [k] is relatively early as shown by *causa* [kausa] > *chose* [ʃo:z], in which the fronting of [k] took place before [au] was

¹² J. R. Aiken, *Why English Sounds Change* 22-3 (New York, 1929): 'Accord in speech may be defined briefly as that principle whereby a speaker tends to harmonize speech sounds. In another aspect, it may be termed the tendency of spoken language to become progressively more simplified, hence more efficient (not always more "easy") in its sound patterns. More specifically, accord is that principle in language by whose operation sounds tend to repeat or to approach in manner or place of production, other sounds, whether immediately contiguous in utterance or more remote.'

¹³ Stetson, *op. cit.* 65, 119 ff. Rousselot-Laclotte, *Précis de prononciation française* 81 (Paris, 1927): 'Si deux consonnes s'appuient sur une seule voyelle (psaume, p'tit, ou apt'), leur union est plus étroite que si elles s'appuyaient sur deux (aptitude).' *Ps* of *psaume* is a releasing group, comparable to [kj].

simplified to a single [o]. Even though the presence of the sound [y] in Romance territory which had originally been Celtic might lead to the assumption that it is part of the Celtic substratum, such a delay in its appearance in French would make the conclusion difficult. Clearly if Latin [u:] was pronounced [y] by the Celts the change would have been one of the first to take place in the pronunciation of Latin in Gaul. For lack of any physiologic necessity, as far as we know, for the fronting of [u] to [y] it is considered a social rather than a purely phonetic phenomenon. At present, however, [y] causes a fronted articulation of [k] preceding it, quite comparable to the combination [ki] (Figure 3).

Another argument for the late development of [y] is the fact that when [ɪ] became vocalized to [u] (beginning of 12th century), spelled *u*

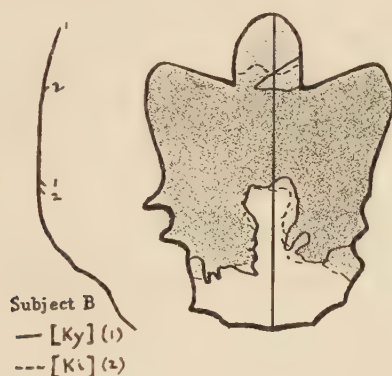


Fig. 3

and *o*, the vowel descended from Latin [u:] was also represented by this same letter *u*. It is safe to conclude that the vowel sound represented by this spelling was still [u]. The development of the diphthongs [au, eu, ue (oe)] which give respectively in MFr. [o, ɔ], [ø, œ], [ø, œ] shows also that the latter part of the diphthongs was [u] or [ũ] and not [y] or [y].

SUMMARY OF CONSONANT CHANGES

Fronting of Back Consonants:

- in strong position: initial of word, initial of syllable following another consonant;
- between vowels;

in weak position: followed by another consonant;
in consonant-group.

Consonants influenced by [j], not fronted:

dental;
denti-gingival;
labial.

Loss of consonants:

occlusives: between vowels, in final position;
constrictives: in weak position, final of word or of syllable.

CHAPTER II. THE INVESTIGATION

THE PROBLEM

Since, in the history of Vulgar Latin developing into Modern French, the most important single factor is the influence which one articulation has upon a neighboring one, or the mutual influence of sounds in groups, the problem was to get objective evidence on the habits of French articulations as they affect one another. Therefore combinations of sounds such as were to be found in Vulgar Latin were used as material of investigation, pronounced by two French subjects. For instance, the influence of a front vowel upon the articulation of a back consonant is a factor in the development of a word like Latin *cyma* ['kima] > *cime* [sim]. The combination [ki] in initial position could be got by having the subject pronounce the French word *qui*.

SUBJECT A

Subject A was a young theological student, born in Paris, in 1905. His father is a Protestant pastor, settled in Paris with his wife, both having come from the Midi. Subject A has lived in Paris all his life, where he attended secondary school and university. He has studied Hebrew and Arabic. Travels include a short stay in Syria and Africa, and, at the time of the investigation, a year of residence in the United States. He does not speak English perfectly.

MEANS OF INVESTIGATION.—Subject A served for the investigation of consonantal articulations by means of X-ray photography. The subject is seated with his back firmly against the back of a chair, his arms resting on the arms of the chair. His head is strapped in a head board, which prevents him from turning to left or right, and from tilting his head back or forward. This assures comparable separate radiographs. The outline of the median line of palate and tongue are guaranteed on the radiograph by the presence of metal markers, which throw a clear line of shadow upon the X-ray film. For a more detailed description of the technique employed, see the article by Parmenter, Treviño, and Bevans.¹ All the radiographs were made in the laboratories of the Roentgenology Department of the University of Chicago.

¹ C. E. Parmenter, S. N. Treviño, and C. A. Bevans, A Technique for Radiographing the Organs of Speech during Articulation, in *Zeitschrift für Experimental-Phonetik*, Vol. I, Heft 2 (July 1931).

LINGUISTIC MATERIAL USED.—Each sound to be recorded by X-ray was incorporated in a word or group written on a separate card. This was handed to Subject A. The investigator avoided pronouncing the word in question. A list of words and groups used is given in Appendix A.

PROCEDURE ADOPTED FOR THIS INVESTIGATION.—The subject was not told the object of the experiments. Conversation between him and the investigator was carried on in French. At the beginning of each session he was asked to assume the position required for the experiment with his head fitted in the head-board. Then about ten minutes was employed in allowing him to become accustomed to these trappings.

When he had become sufficiently accustomed to the surroundings, so that his pronunciation showed no observable modification, he was given in writing words which embodied the sounds to be studied. In each case the consonant to be radiographed was preceded and followed by the same vowel: [aka], [ili], [upu]. The subject pronounced several times the word in question, then again, prolonging the medial consonant so that an exposure of seven-twentieths of a second could be made. At a signal from the investigator, signifying that the exposure was over, the subject finished the pronunciation of the word.

GRAPHIC PRESENTATION OF RADIOGRAPHS.—For the study of radiographs the negative is placed over an illuminator.² The significant parts of the X-ray picture are traced. These include for the purposes of this study the outlines of the palate, comprising the upper front teeth, the bony structure, and the velum; the outlines of the tongue and the epiglottis. The pharyngeal wall and the outline of lips and chin are also traced. The bony structure of the roof of the mouth, the upper incisors, and the hard palate are the same in all the radiographs of the same subject, since these parts are immovable in relation to the head-board and hence to the X-ray tube and the X-ray plate.

The size of the radiographs taken for this investigation bears a relationship to actual size of eleven to ten. Therefore the tracings were reduced to actual size by means of a specially devised illuminator. This is composed of a baseboard 36 inches long, near one end of which a grooved frame is set at right angles to the board. Into the frame fit two panes of glass about 6 inches on a side. Between these the oversized tracing is placed. Light shining from behind this frame is furnished by a strong bulb in a desk lamp.

² For details, see Parmenter and Bevans, *Analysis of Speech Radiographs*, in *American Speech* 8.3.44-56 (1933).

Facing the frame holding the objective, and fixed to the base-board, is a camera provided with a portrait lens (Eagle Portrait Lens No. 4, 4 x 5, 1 7/16 in.). Instead of the film holder at the back of the camera, a piece of clear plate-glass is fitted to the camera box. The focus is adjusted to give the exact reduction desired and all moving parts are fixed with screws to the base-board. Tracing paper laid on the plate-glass back of the camera is used to trace the image reduced to actual size. This process is best performed in a darkened room.

SUBJECT B

Another means of investigating articulatory positions of the tongue is the artificial palate. For this purpose a second subject was used. Subject B was born in Boulogne-sur-Seine in 1902. His father was a Paris-born lawyer, whose grandparents had come to Paris from the department of Ardèche. The subject's mother was Russian. French is the only language spoken in their home. Subject B has traveled in Europe and North Africa, and had lived in the United States, at the time of the investigation, a total of three years' time, not continuously. He speaks no foreign language other than English. In addition to the palatograms furnished by Subject B, the author (Subject X) presents a number of palatograms of his own to exemplify articulations which were not found in the normal speech of Subject B. These palatograms of Subject X are presented, not as evidence, but as conjectural articulations. (See Figs. 13, 14, etc.)

THE ARTIFICIAL PALATE.—An artificial palate was made for the subject by a dentist. It was of bakelite, 0.5 mm. thick. It extended from the lower edge of the upper incisors to the soft palate, and on the sides to the inner edge of the molars. Fear of biting through the thin and brittle artificial palate made it inadvisable to have the artificial palate extend to cover the grinding surfaces of the molars. The rigidity of the artificial palate made possible its removal from the mouth without distorting the image. It fitted the surface of the palate so closely that the subject was able to speak at length without any inconvenience to him or any observable modification in his pronunciation.

The artificial palate was coated with a dull black paint. Dusting it with various white powders proved unsatisfactory. The line of demarcation between area touched by the tongue and areas not so touched during articulation was not clearly defined. Finally a mixture of one part washing starch (Argo) and two parts of water, sprayed on, was found to give good results. For spraying an insecticide spray-gun

(like that used for 'Flit') was held at from three to four feet from the artificial palate, which was placed for this operation on a plaster mold in a vertical position. It is important that the artificial palate be dry when it is sprayed, for if it is wet, the solution will spread and make a blurred coating of white. The despatch of these processes is an important element in the conduct of this experiment. If too much time elapses between articulated sounds with the artificial palate in the subject's mouth, he becomes disused to the feel of it, and the result is a less natural articulation.

The drying of the artificial palate preparatory to the application of the starch solution, and the drying of the starch solution after its application were both speeded up by the use of a small inexpensive hair-drier (an electric fan blowing air over a heating unit).

The rigid artificial palate cannot cover the roof of the mouth farther back than the posterior edge of the hard palate. Several articulations, however, bring the tongue into contact with the velar region. Following Rousselot's example, therefore,³ a strip of paper was pasted on the artificial palate to extend the median line beyond the hard palate by about $\frac{3}{4}$ of an inch. This 'languette' was about $\frac{1}{2}$ of an inch in width. It was affixed to the artificial palate with rubber cement. The requirements for this strip are several: first, it must be somewhat porous so that it will cling to the wet surface of the velum; second, it must be pliant enough to follow the movements of this organ; third, since the under surface is to be covered with black paint like the artificial palate itself, it must have a fairly smooth surface for this coating. After several experiments with various kinds of paper, ordinary pharmacy filter paper was selected. The surface to be painted was covered with powdered wax, which was rubbed into the pores, thus making a smooth base for the paint; the surface which was to come in contact with the velum was left unchanged. When the artificial palate was placed in position, the languette usually clung to the velum, but no effort was made to push it against the velum because of the discomfort it might have occasioned the subject. Only in a few cases did the tongue, in the course of the articulation, bend this languette.

LINGUISTIC MATERIAL USED.—For each palatogram Subject B was given a word incorporating the sound to be studied in the combination desired. A list of these words is given in Appendix B.

PROCEDURE ADOPTED FOR INVESTIGATION WITH THE ARTIFICIAL PALATE.—The subject was not informed of the object of the investiga-

³ *Principes de Phonétique expérimentale* 2.910 (Paris, 1925).

tion. At the beginning of each session with the investigator, the subject placed the artificial palate in position and some ten minutes' time was taken up in conversation in French between the subject and the investigator. This was to let the subject become accustomed to having the artificial palate in his mouth. Then the subject was given in writing the first word to be pronounced. He practiced this, and meanwhile the investigator transcribed in phonetic symbols the subject's pronunciation upon the marker which appears in the palatogram photographs. (The number on the marker has no significance in relation to the sound; it is used simply as an ordinal. Cf. Figs. 5, 6.)

The artificial palate is removed from the subject's mouth, washed and sprayed with starch solution. This is done as quickly as possible. Then the artificial palate is placed in position, the word is pronounced, the artificial palate removed again and photographed.

The subject is seated in a comfortable chair, leaning against the back with his head in a head-rest devised to keep him from tilting it back or forward, or to either side, in order to avoid the distortion which would result from changes in position of the subject's head.⁴

PHOTOGRAPHING THE PALATOGRAM.—An inexpensive camera was used. It accommodated a film pack of 4 x 5 inches, and was furnished with a portrait lens (see p. 27 above). The focus was such that the image on the focusing ground glass was of exactly the same size as the false palate, the point of greatest clarity being in the plane passing through the middle of the depth of the palate. A plaster mold of the palate was placed on a vertical objective holder, in such a position that the surface of the back molars and the edge of the incisors lay in the same vertical plane. Exposure, 1 second; single source of light, Mazda photoflood lamp, 105–120 V.

TRACING THE PALATOGRAM.—Two main reasons for tracing the palatogram are to be considered: first, when dealing with articulations which belong to a series of shifts in articulatory position, such as the history of fronting [k] before [i], for instance, the main approach is a comparative study of successive articulations. This requires that two palatograms be brought together on the same paper to make the differences apparent. Second, if the films themselves are used and superposed, the opacity prevents distinguishing clearly the details of the outline.

The negative is placed with the sensitive side against the glass, thus

⁴ E. Emmett, *Phonetic Studies with the Artificial Palate* (unpublished master's dissertation, University of Chicago, 1931).

giving a tracing equivalent to the print. Both the negative and the tracing paper are held in place by the use of 'Art Corners' for mounting photographs. This does away with push-pins which mar the negative and are apt to get in the way of the tracer's hands.

METHOD OF SHOWING LONGITUDINAL AND LATITUDINAL DEPTH OF THE PALATE, IN CONJUNCTION WITH THE PALATOGRAM.—The palatogram has the disadvantage of presenting as a flat surface the picture of a concave object. On any palatogram, the area which appears as having been touched by the tongue is not wholly representative of the actual area so touched. The surface of the artificial palate slopes at various

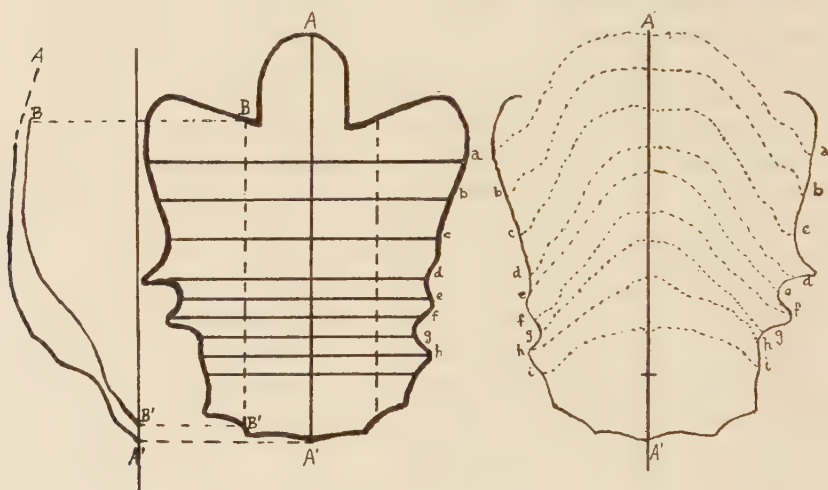


Fig. 4

angles away from the observer. It was therefore advisable to outline sections of the palate, along the median line, from incisors to velum, and to one side of this median line, for the longitudinal cross-view, and also latitudinally at right angles to the median line.

A plaster of Paris mold was made containing a depression into which the artificial palate fitted exactly. The median line as determined from tracings of palatograms was marked on this mold. Sculptor's clay was used to fill up half of the mold. Plaster of Paris was poured into the other half. This gave a negative of half the palate cavity, and the edge of this negative cast outlined the median section. A similar negative was taken in the same way, 1 cm. to the left of the

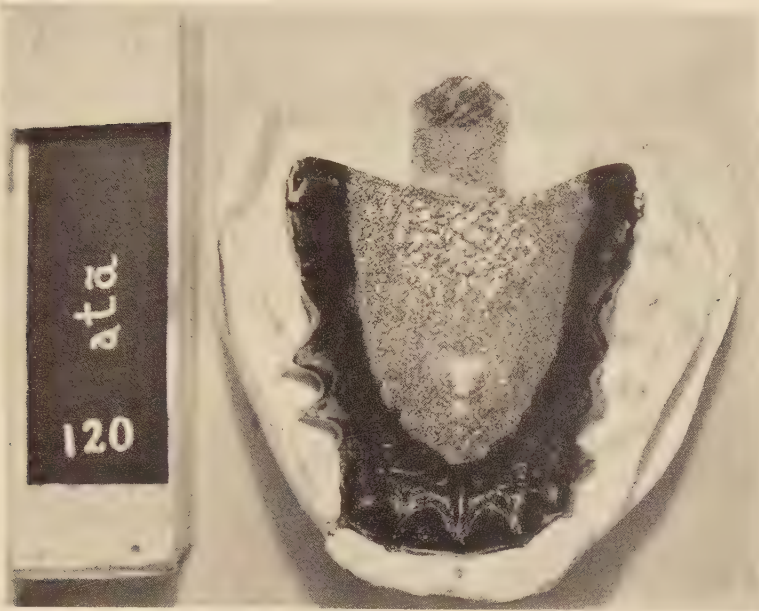


Fig. 5



Fig. 6

median line. (See Fig. 4. AA' marks the median line; BB' the left section.)

In the same manner, using sculptor's clay to dam off the palate cavity, and casting with plaster of Paris, each of nine latitudinal sections was obtained. These are at right angles to the median line. The outline of each can be plotted against the appropriate level in the palatogram tracing, for analysis.⁵

⁵ A similar attempt at showing depth in connection with palatograms had occurred in Mme. Varney's *Etudes sur l'L américain* (Paris: Presses universitaires, 1933).

CHAPTER III. THE FRONTING OF BACK CONSONANTS

We have seen (p. 17) that, in French, accord is much closer between consonant and following vowel than between consonant and preceding vowel.

In the radiograph of Fig. 7 is shown the tongue position during the articulation of the medial [b] in the word *bibi*. The subject was instructed to pronounce the word and to hold the position of the medial [b] long enough for the X-ray exposure. It will be noted that during the lip-occlusion the tongue approximates the position for the vowel which is contiguous to the consonant radiographed. The tongue shows two lines which are due to motion of the tongue during the exposure. This fact shows by inference that the tongue position is not part of the [b] articulation, but simply an anticipation of the vowel position. Similarly in Fig. 8, the tongue position for the vowel [u] is anticipated. The exposure was made during the occlusion for the medial [p] of the word *poupoule*.

In these two cases the tongue is not actively involved in the production of the consonant, and is therefore free to move toward the position for the vowel. But even in the case of consonants which require tongue activity, the influence of the vowel on the consonant articulation is noticeable. Fig. 9 shows the tongue position of [k] before [i] and also that of [i] alone. The accord is not so complete here, as in the case of the two labial consonants, but the tendency is unmistakable. It may be seen that the back of the tongue must move forward considerably to arrive at the full [i] position. This forward movement is responsible for the tendency to release the closure with a forward movement of the blade. Since the back of the tongue has farther to travel, it starts forward and down sooner than the middle blade which is already nearer the position it is to occupy for [i]. The tip of the tongue will reach down close to the lower incisors, even touching them often, for [i]. This will cause the median line of the tongue to contract in order to thrust the tip forward. Furthermore, the sides of the tongue blade stay against the palate for the vowel, whether [i], [e], or [ɛ] (Figs. 10, 11, 12). Thus it is that the median region only of the tongue moves away from the palate in the first part of the détente. During this short period the air escaping through this narrow channel produces audible

friction, the characteristic of the end of an affricate occlusive-constrictive articulation.

Latin [k] > French [s], [ʃ] or remains [k]. The first two concern us here: [k + i, e, ɛ] and [k + a] (see Figs. 13 and 14 respectively). *Cyma* [kima] > *cime* [sim]; *cera* [kera] > *cire* [si:ʀ], *caelum* [kelu] > *ciel* [sjɛl]; *caput* [kapu] > *chef* [ʃɛf]; **corpum* [kɔʀpu] > *corps* [kɔ:ʀ].

The palatograms of the front vowels [i], [e], [ɛ] show particularly one

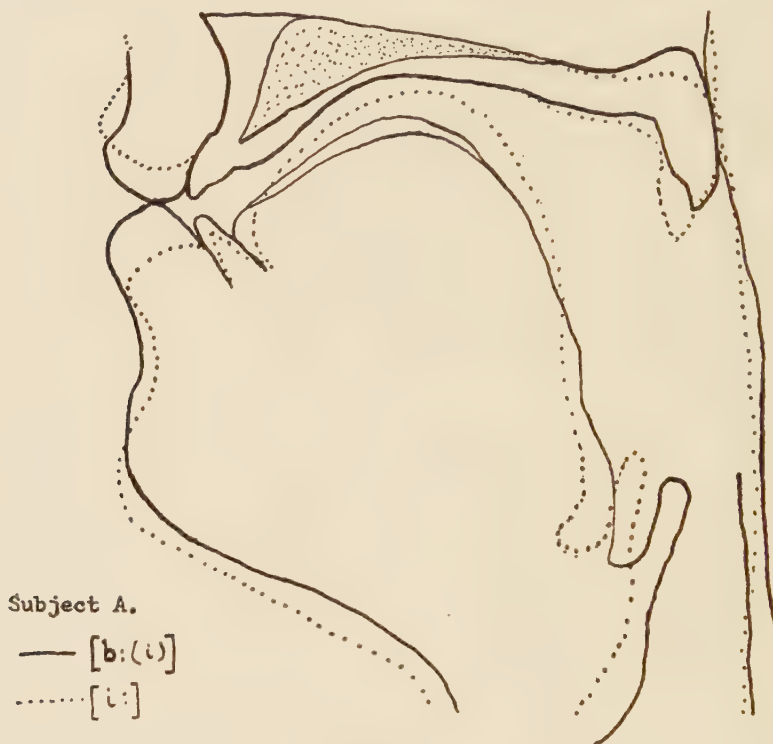


Fig. 7

tendency in common: the tongue touches the palate on both sides for all three to a greater or lesser degree.

BACK CONSONANTS IN STRONG POSITION

[k] IN STRONG POSITION, BEFORE [i, e, ɛ] AND [a].—Even if the Modern French pronunciation of a given sound or sound-combination, [ki] for example, is not absolutely that of the inhabitants of Gaul at the

time they learned the Latin language, still it is the nearest thing to it available to the modern investigator.

It is therefore assumed, and with reasonable certainty, that fronted [k] was affricated, just as the same combination tends to be affricated in Modern French, according to the process detailed above.

The articulation of an affricate occlusive-constrictive requires a 'point d'appui', a 'point' at which the tongue may press against the

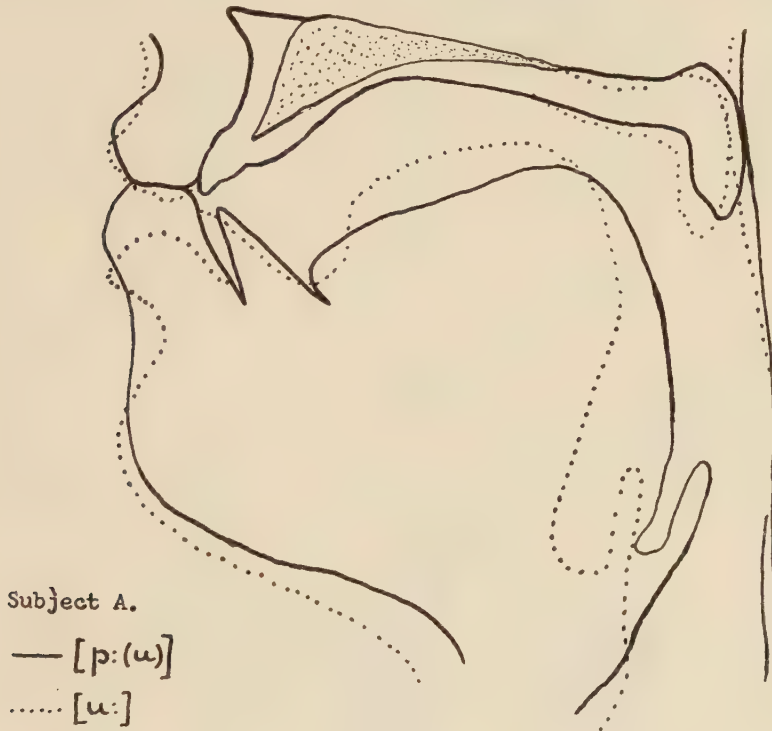


Fig. 8

palate, in order to spread, forward or backward as the case may be, and in order to facilitate the median release. This latter is necessitated by the vowel following, as has been seen. It is very likely that the tongue may take this point d'appui not in one place but on both sides of the hard palate, either in front of or behind the middle, the highest region of the palate. If the closure is actually made just behind the middle the impression is that of [k]. If its détente is fricative, we have

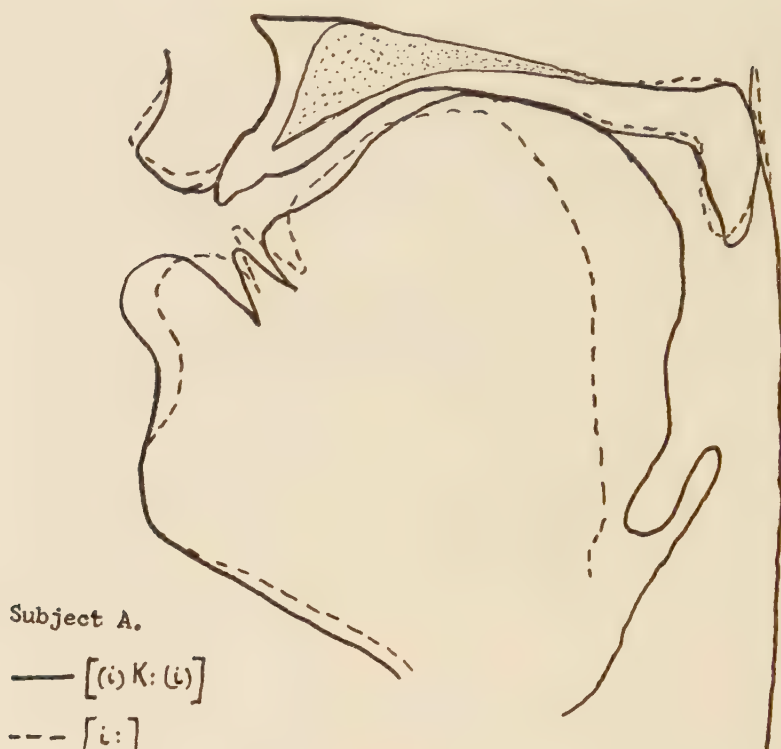


Fig. 9

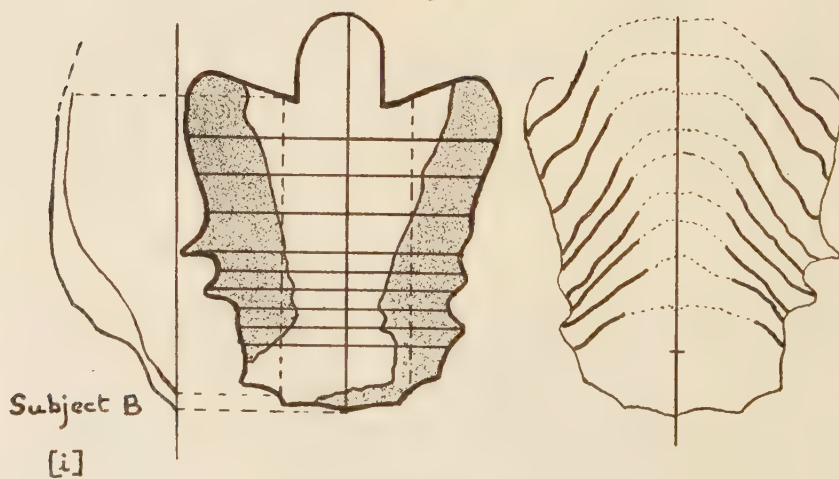


Fig. 10

the impression of an affricate occlusive-constrictive. If the occlusion is made just in front of the mid-palate, the impression is that of a kind of [t + friction], in other words an affricate [t] or [tʃ] (Figs. 15, 16), provided that the occlusion is clearly perceptible. In case, however, the occlu-

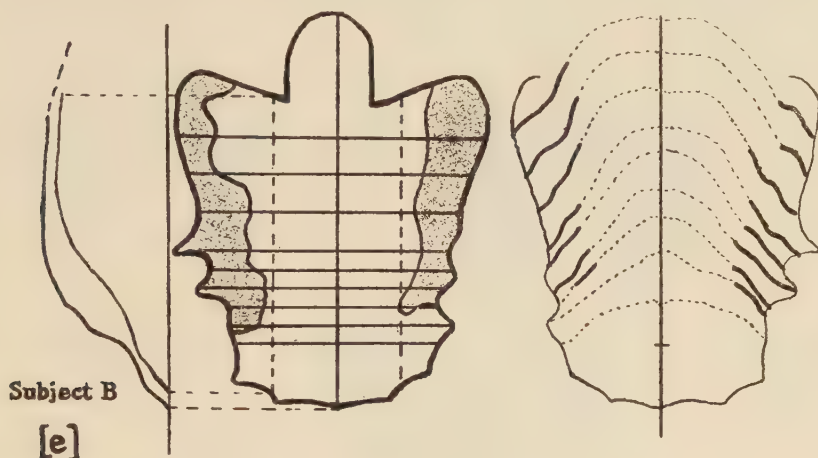


Fig. 11

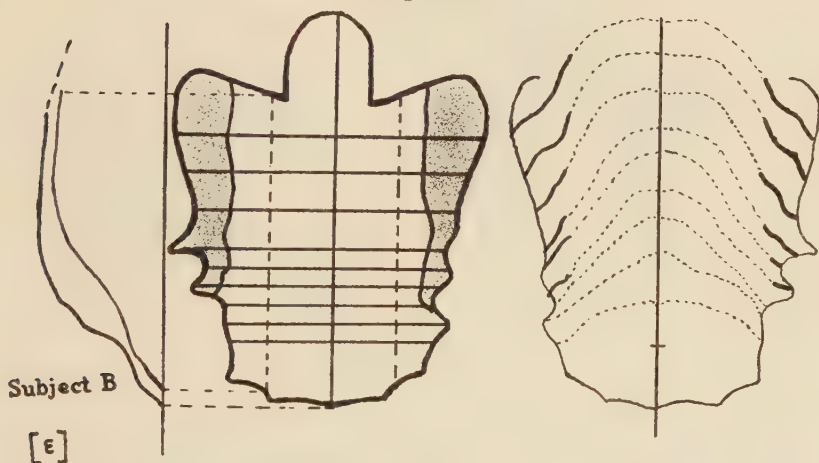


Fig. 12

sion is short with corresponding reinforcement of the fricative element the two sounds [k] and [t] are not easily distinguishable. This situation undoubtedly existed at a very early date in VL, attested by the very numerous misspellings, showing confusion between [kj] and [tj].

The main factors operative in the process of fronting are then: (a) the necessity of the back part of the tongue moving a relatively great distance forward to reach the position for the front vowel; (b) the fact that during the vowel the sides of the tongue will be against the palate, so that these regions are the points d'appui for the articulation of the

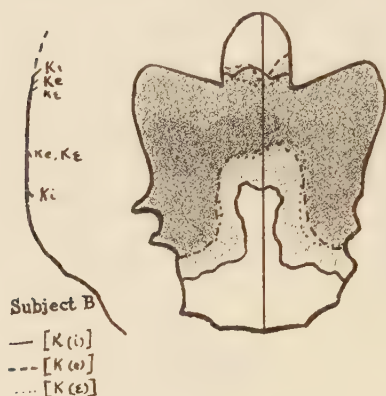


Fig. 13

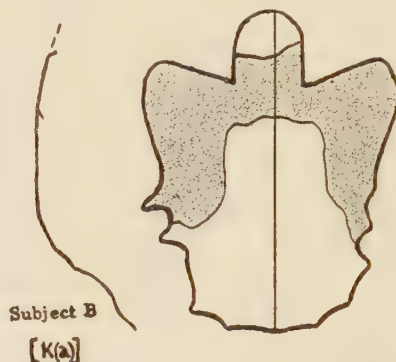


Fig. 14

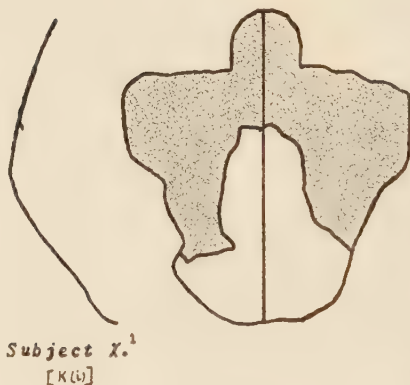


Fig. 15

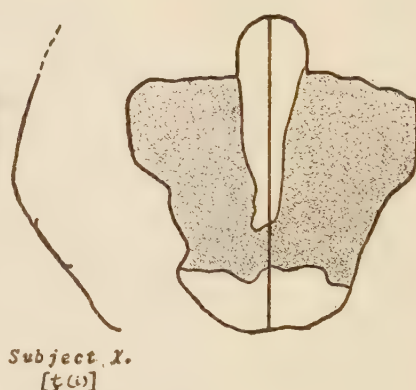


Fig. 16

occlusive-constrictives. This last mentioned fact gives rise to the median release, which itself is directly responsible for the fricative

¹ Subject X is the author of this study. He began to learn French at the age of eight. He lived in Neuchâtel, Switzerland, for some eight years, and went through public and secondary school there.

element audible in the détente. It is presumably impossible for the tongue to move away from the mid-palatal contact with a 'clean' release. By 'clean' is meant an unaspirated, nonfricative, explosive release. (This factor will be touched upon again in connection with consonants, both back and front, in accord with [j]; pp. 58, 75.)

In Italian the result of the inherent 'difficulty' of the mid-palatal articulation seems to be to reinforce the occlusive element by lengthening, which is concomitant with greater pressure of the tongue. In French, a language which consistently shortens prolonged occlusives, [t:] had little chance of surviving. Fig. 17 shows that a short [t] is characterized by an occlusion which does not reach as far back along the median line as is the case in the prolonged [t:].

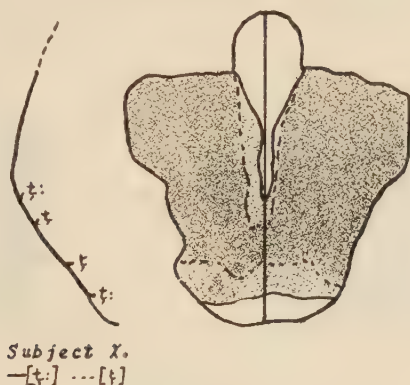


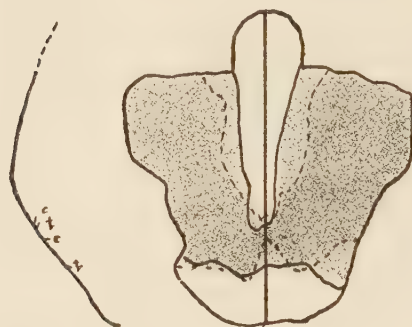
Fig. 17

Fronting from the position of [t] is not due to the need of bringing the postdorsal region of the tongue forward, in anticipation of the vowel position, as in the case of [k̄], but rather it is due to the tendency to bring the predorsal part and the tip of the tongue down toward the lower incisors. The process is observable in the exclamation *tiens! tiens!* which is ordinarily pronounced [t̃ t̃] or even [c̃ c̃] rather than [tj̃ tj̃]. This accord can be explained as follows: the voicelessness of [t] spreads to the following [j] and gives rise to the pronunciation [t̃j̃], the position of the closure being pulled back from the upper incisors to a prepalatal region. This is, however, not a complete accord, and the fricative element (the release of the occlusion) is pulled forward to a position like that for [f]. Thus from [t̃j̃] the pronunciation goes to [t̃f̃] or [c̃]. It is to be noted that the articulation is a single one, an

occlusive-constrictive affricate. The shift from the stage [t] forward is a similar process giving [ci].

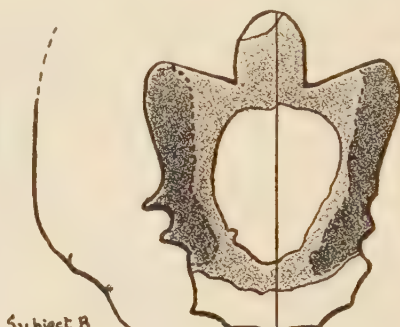
Up to this point [k] before all four front vowels acts in the same manner ([k + i, e, ε, a]). But [k + a] is not fronted beyond [c].

There is, in what has been called 'une prononciation des boulevards', a variety of [a] sound which is really [æ]. It is used especially before [ʀ] as in *tu parles!* Subject A was asked to pronounce the vowel [a] in the example given here. Fig. 20 is a tracing of that radiograph. This [æ] may well have been the general pronunciation of Latin [a] unchecked through the major part of northern Gaul.² *Caballu* > *cheval* [cəval] in OFr. and [ʃ(ə)val] since the thirteenth century. *capu* > *chief* [cʲɛʃ], ModFr. [ʃɛʃ]. But whether the vowel is pronounced [a] or [æ], the pull is no longer front, it is down.



Subject X.
—[tʲɔ] ---[cʲɔ]

Fig. 18



Subject B
—[tʲɛk]
---[ʃ-]

Fig. 19

The consonant articulation in the combinations [ci, ce, cε] undergoes another change before the literary period of OFr. It is a further fronting, with no change in manner (occlusive-constrictive) or voice, but only in position: [c] > [ts]. This fronting is somewhat surprising, if we think only of the fact that the vowels [i, e, ε] are what might be called prepalatal, the tongue hump being opposite that region of the palate. How then is the articulatory efficiency increased by moving still farther forward? The answer is to be sought again in the direction of release,

² See Kr. Nyrop, *Grammaire historique de la langue française*³ 1.188-9 (Copenhagen, 1914).

and in the tenseness of the consonant in strong position. Furthermore, the tongue tip is more agile than any part of the blade.

Thus the articulatory point is moved a little forward from the point d'appui. The resultant articulation is the predorso-dentingival

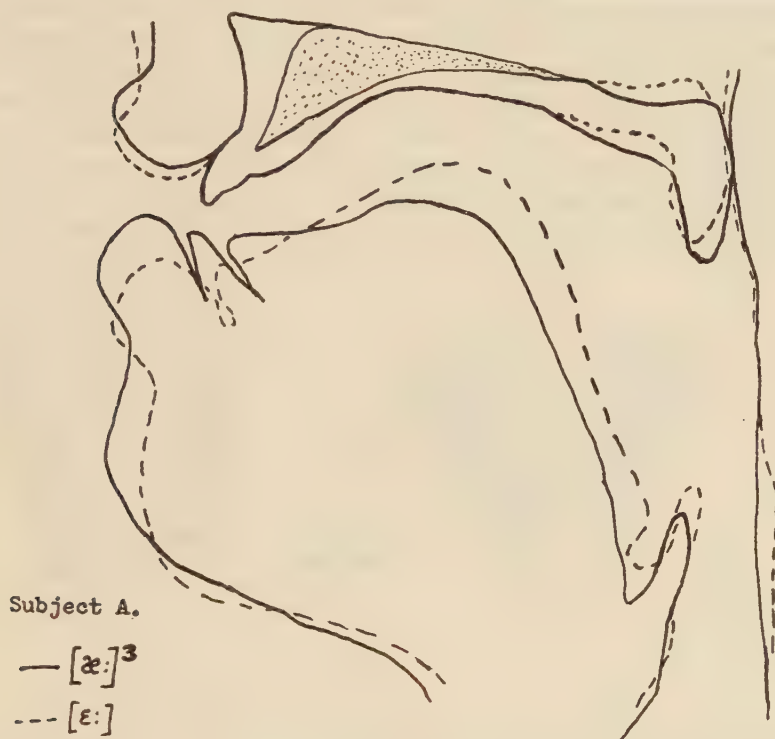


Fig. 20

occlusive-constrictive [ts].⁴ ModFr. does not have this articulation. Fig. 22 shows a palatogram of the combination [t + s] in the word *médecin*. This does not represent the single articulation [ts] mentioned above.

The shift from [c] to [ʃ] on the one hand, and from [ts] to [s] on the other is completed in the 13th century. The process has its parallel in

³ The fact that this sound is heard only preceding an arresting [ʀ] and in stressed syllable, in other words when it is prolonged, offers a fair analogy with Latin stressed, unchecked [a:].

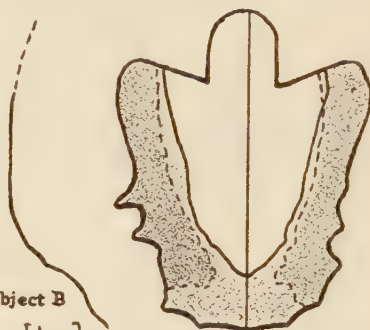
⁴ Fig. 21 shows the steps in the chronological sequence of articulations.

modern times. Henri Bauche⁵ mentions the pronunciations [syʒɛsjɔ̃] and [kɔʒɛsjɔ̃] for the words *suggestion* [syʒɛstjɔ̃], *congestion* [kɔʒɛstjɔ̃]. In both words the last syllable beginning with the combination [tj], occlusion + constriction, suffers the loss of the occlusive. There seem to be two tendencies working together to this end. First the application of the principle of inertia stated above (p. 21) by which a closure between two more open articulations tends to be opened. Occlusives open to fricative constrictives, and so forth. Here between the constrictives [s] and [j], the occlusive [t] is relaxed. The outcome of this process is determined by the other aspect of the situation: [s] is predorso-lingival, [j] is prepalatal, whereas [t] is dental. Therefore the motion from [s] to [t] is forward, and from [t] to [j] back again. The simplification of the



Subject X.
— [c(ɥ)] --- [tʃ(ɥ)] [s(ɥ)]

Fig. 21



Subject B
— [ts-]
--- [-s-]

Fig. 22

three-consonant group brings about the loss of that element which requires a motion contrary to the general direction. This consists of the movement from [s] to [j], both of which are highly audible and hence essential to the recognition of the word. In the accompanying graph only the 'region of articulation' of the tongue has been marked to facilitate the analysis (Fig. 23).

In strong position in the body of a word, that is, following a consonant, the occlusive-constrictives [c] and [ts] were in circumstances similar to the [tj] combination in the examples cited by Bauche. In the words from Latin *arca*, *mercede*, pronounced in the 12th century [arɔ̃], [mertsɪ] respectively, the occlusion involved in the occlusive-constrictive articu-

⁵ H. Bauche, op. cit. 51: (t) tombe dans certaines finales en *tion*: *sujession* ('suggestion'), *congestion* ('congestion').

lation is between constrictive elements. The occlusive element is, in a manner of speaking, an interruption of the flow of speech. Of the two elements of an occlusive-constrictive articulation the fricative constrictive element is the more audible. If one or the other element is to be lost the occlusive element is the lesser loss, for the retention of the fricative element preserves the auditory effect of the articulation better. Thus [c] losing its occlusive element and pronounced [ʃ] more nearly satisfies the ear than if the fricative element were lost leaving the articulation some kind of [t]. Similarly, [ts] loses its occlusive element and becomes simply [s]. (In Italian today words like *forse*, *falso* are frequently heard pronounced [fortse, faltso] rather than [forse, falso]. The interchange of [ts] and [s] seems to impair the intelligibility of the word not at all when they occur after another consonant, especially one articulated with the tongue-tip.)



Fig. 23

There is no evidence to support the hypothesis that [c] > [ʃ] and [ts] > [s] first within the word and then only initially. Such an order of events would not be surprising, however. Once [arcə] had become [arʃə] and [mertsɪ] [mersɪ] it would be quite natural for [catə] to become [ʃatə] and [tsirə] [sirə].

[k + i, e, ɛ] > [s]

cyma(m) [kima] > [ʧimə] > [cimə] > [tsimə] > [sim]

mercede(m) [merkede] > [merʧejd] > [mercɛjt] > [mertsɪ] > [mersɪ]

[k + a] > [ʃ]:

carru(m) [kar:u] > [ʧar] > [car] > [ʃar] > [ʃa:r]

mercato(m) [merkātu] > [merʧæt] > [mercət] > [marce] > [marʃe] > [marʃe]

⁶ The tracing for [j] is not taken from a radiograph but from a palatogram.

Of course only the last two pronunciations in each series are actually instanced.

[g] IN STRONG POSITION FOLLOWED BY [i, e, ε, a].—In modern French the occurrence of prolonged occlusive consonants is relatively infrequent. Medially original doubles have been simplified: *aller* [a'le]. But groups of words do present the situation of arresting-releasing pairs, as (*le*) *bac qu'a* . . . , (*une*) *bague gar(nie)*, etc. Such a combination was used for the palatogram shown in Fig. 24. The prolongation involves on the part of the tongue a greater spread against the palate than for the simple articulation. A prolonged occlusive may then be termed a reinforced articulation, since greater spreading of the tongue must mean a more energetic pushing against the palate.

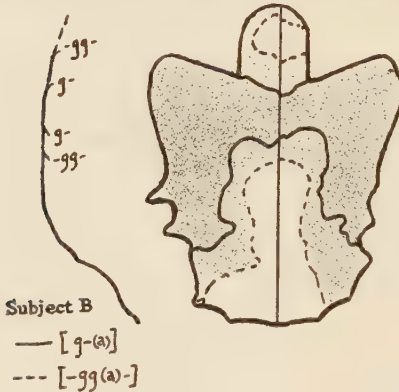


Fig. 24

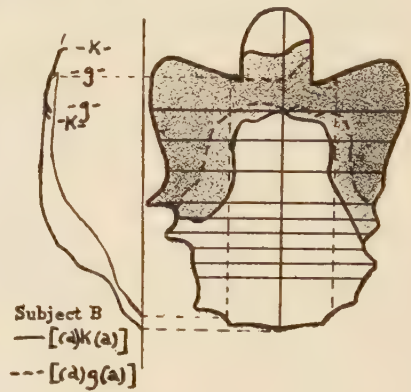


Fig. 25

For the radiographing of consonants, Subject A was asked to hold the position for the articulation in question until the signal should be given to go on to the pronunciation of the rest of the word. The X-ray exposure itself lasted seven-twentieths of a second. Of course the actual prolongation of the consonant was for an even longer time than that. This abnormality was wittingly introduced into the experiment, for the sake of the clarity of the X-ray picture. From the fact that normal prolongation, such as occurred in the palatograms, brought about greater area of contact than the simple articulation, it is inferred that the area of contact as such in the radiographs is also greater than normal. We do not therefore consider the extent of the contact shown in the radiographs as significant. The radiographs must be checked against the palatograms, for a correction of this inaccuracy.

Reference has already been made (p. 16) to the fact that the voiceless consonant is more tense than the voiced counterpart, when both are in the same position in the syllable (Fig. 25). Apart from the element of spreading, which has just been mentioned, the significance of the above radiograph tracing lies in the noticeable fact that [g] is pulled forward farther than [k] when they are both followed by [a]; in other words, the voiceless back consonant resists fronting somewhat better than its

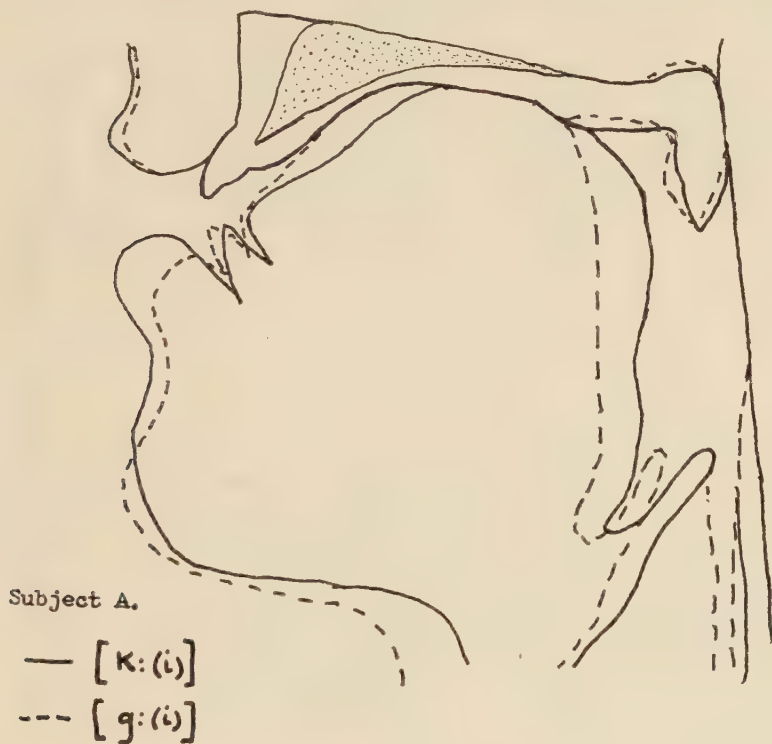


Fig. 26

voiced counterpart. It is noteworthy that [g] was fronted earlier than [k] when occurring before a front vowel.⁷

As in the case of [k + i] (p. 33), the pull from [g] to [i] is forward, especially for the back part of the tongue. The tracing of the radiograph in Fig. 27 shows this clearly. Two palatograms were made for [gi]. The first appears in Fig. 28. This palatogram shows how the closure at

⁷ C. H. Grandgent, *Introduction to Vulgar Latin* 110 (New York, 1907).

the back of the hard palate disappears as the tongue is pulled forward by anticipation of [i]. The palatogram in Fig. 29 shows a back closure but also a narrowing in the prepalatal region which is evidence of the tendency toward [dj] or [ɟ]. As the posterior closure weakened, the anterior narrowing was doubtless reinforced to a closure [ɟ].

That this shift took place fairly early is attested by the numerous confusions in spelling in Vulgar Latin inscriptions: *Gerapolis* for *Hiera-*

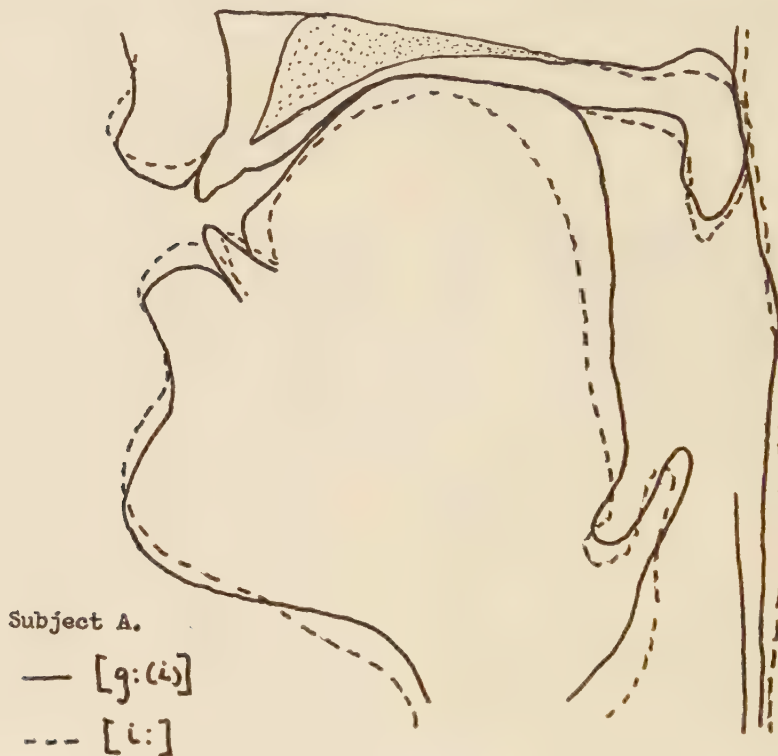


Fig. 27

polis; *zebus* for *diebus*; *Ienubam* = *Genavam* (Grandgent, loc. cit.). The inference from this evidence is that in initial position, at least, the sounds *g* + *i*, *e*; *j*; *di* + vowel; *z* from Greek ζ, had all merged into one pronunciation, namely the predorsal-prepalatal occlusive-constrictive (affricate) [ɟ].

The relative inactivity of the back of the tongue, an essential part of the fronting, continues. From the position of [ɟ] in which the release

of the closure opens a more or less narrow channel down the median of the tongue, and during which the tongue is in a convex position from tip to back (cf. radiograph for [i], Fig. 27), the back of the tongue fails to

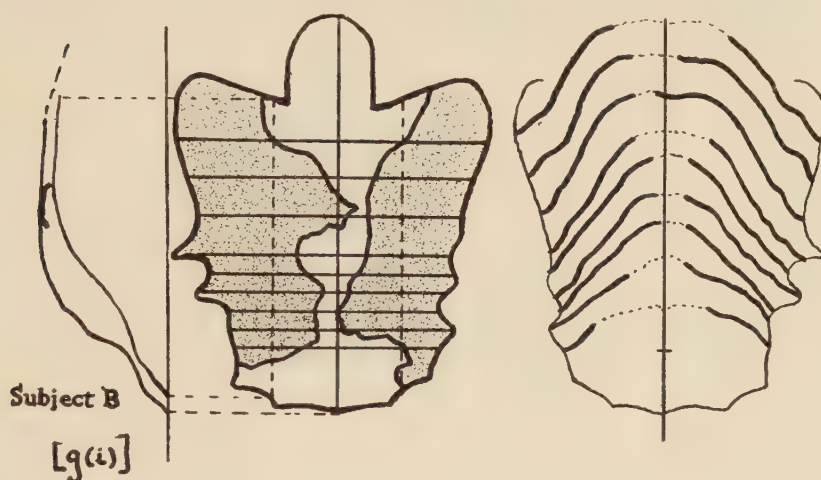


Fig. 28

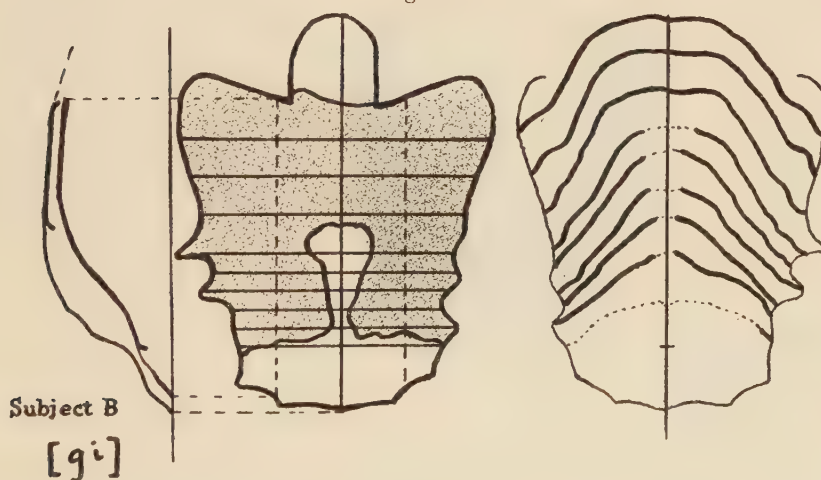


Fig. 29

rise toward the palate, and only the predorsal blade of the tongue touches the gingival-prepalatal region. A comparison of [dj] with [dʒ] (*adjoint*), in Fig. 31, shows that the contact across the median is approxi-

mately in the same position for both sounds. But along the sides the markings for [dʒ] are much narrower.

The passage from [j] to [ʒ] took place in the course of the same period presumably, as [c] became [ʃ] and [ts] became [s], but the voiced con-

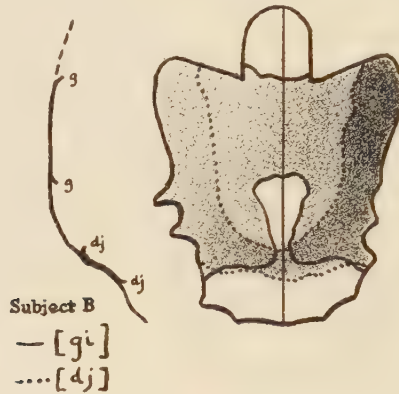


Fig. 30

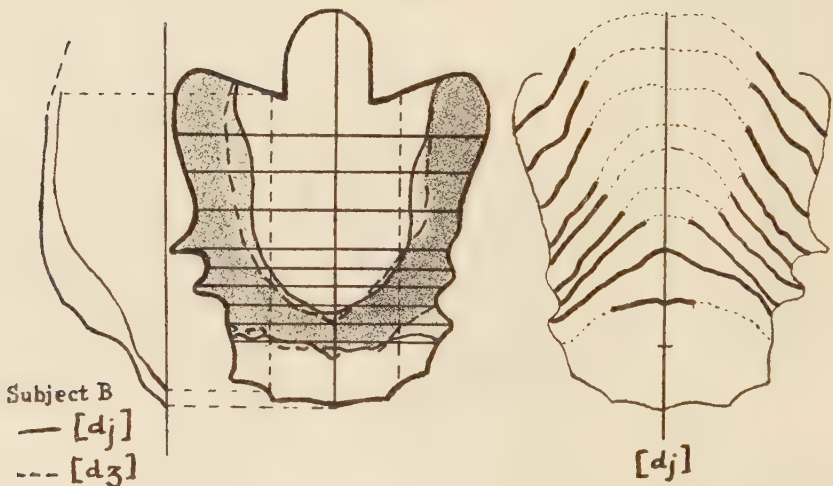


Fig. 31

sonant opened doubtless earlier than the voiceless articulations [c] and [ts]. It is also by the same general practice that this shift occurs: the more sonorous element, the fricative release of the occlusive-constrictive, is increased in length at the expense of the occlusive element.

BACK CONSONANTS BETWEEN VOWELS

[k] INTERVOCALIC FOLLOWED BY [i, e, ε].—The intervocalic voiceless consonants in the history of French were all modified as to voice. Laryngeal inertia brings about the continuance of a voice-glottis (the

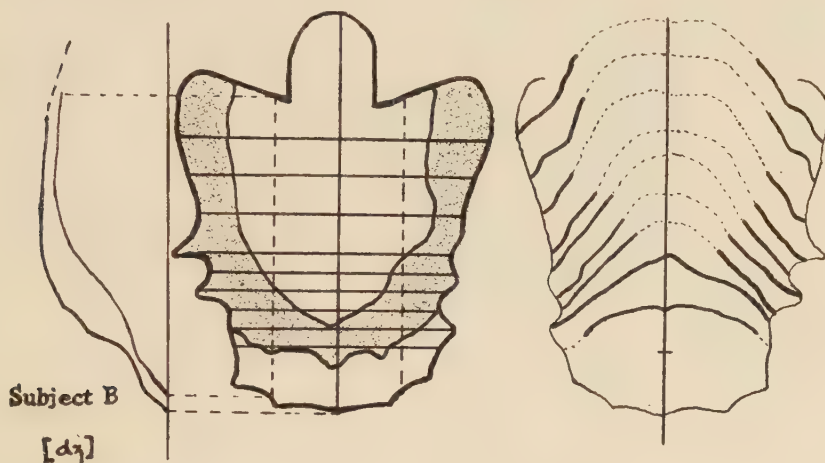


Fig. 32

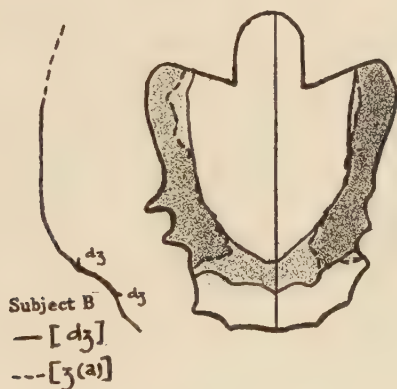


Fig. 33

vocal cords close together, but not closing off the air-column) of the preceding vowel. The vowel following the consonant doubtless exerts a similar influence on account of the tendency to anticipate. Thus intervocalic voiceless consonants become voiced.

In the case of [k] intervocalic the voicing of the consonant takes place

only after the fronting process is completed. The polygram in Fig. 38, of [k] intervocalic followed by [i] and [k + i] initially shows similarity between the two articulations in the contact of the tongue against the

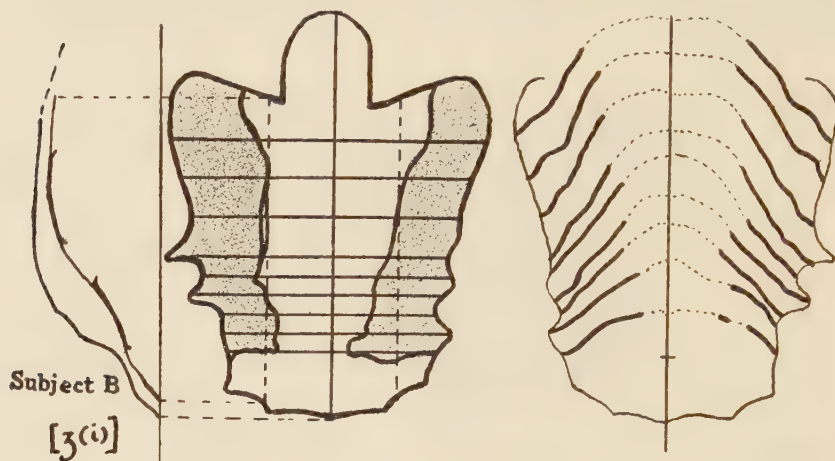


Fig. 34

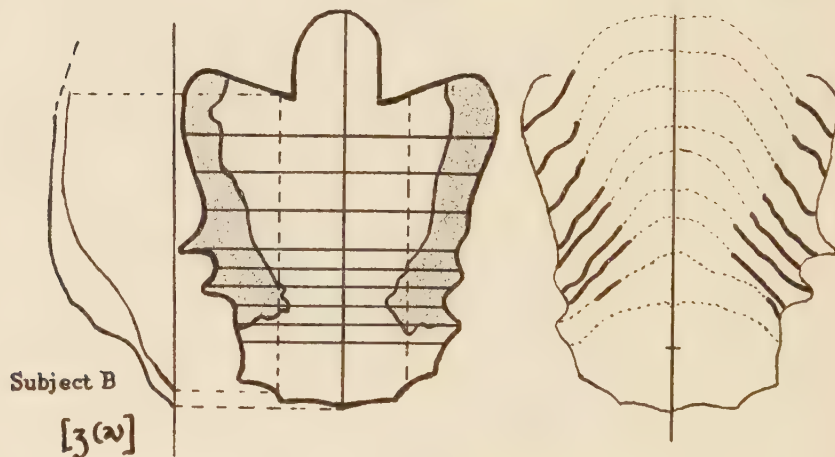


Fig. 35

sides of the palate, ahead of the post-palatal closure. This considerable area is indicative of the fronting influence here as in the case of [k + i] in strong initial position.

The development of intervocalic [k] followed by [i, e, ɛ] parallels that

of [ki] in initial position up to the point of the articulation [ts], that is [k > $\bar{k}$ > $\bar{t}$ > c > ts]. At this stage, if the [ts] is still intervocalic it becomes voiced [dz]; if the consonant has become final it is lost like other final [s] (see p. 106).

The introduction of a glide semi-vowel sound between the relatively open vowel preceding the consonant and the prepalatal [c] is a phenom-

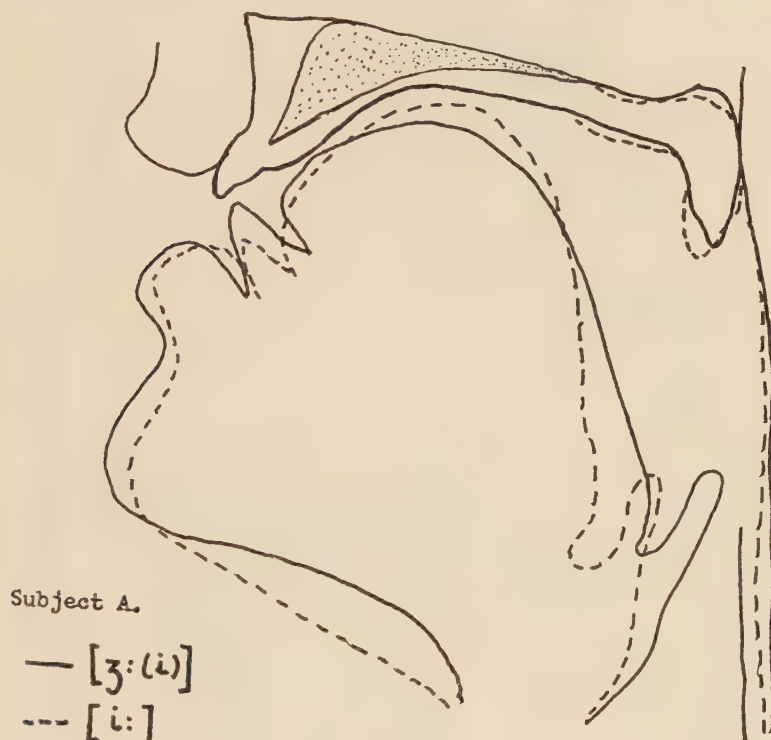


Fig. 36

enon found not infrequently in the history of French consonants. The diagram in Fig. 40 shows a radiograph of [k + i] and the position of the tongue for the glide [j] (see note, Fig. 23, diagram of [j]). No radiograph was available for the articulation of [c], but one can readily realize from an examination of the palatogram in Fig. 18 that the tongue moving up from even close [i] toward the position for [c], passes through the position for [j]. It must be assumed that this motion of the tongue into

position was slow enough to make [j] audible and thus establish it in the speaker's mind as an essential part of the pronunciation. This assumption is necessitated by the influence which it subsequently exerts in lifting [a] in *pacem*, for instance, eventually to [ɛ] as in ModFr. *paix* [pɛ]. The presence of [j] in the diphthong [ej] < [e] precludes the development of a glide due to the consonant articulation.

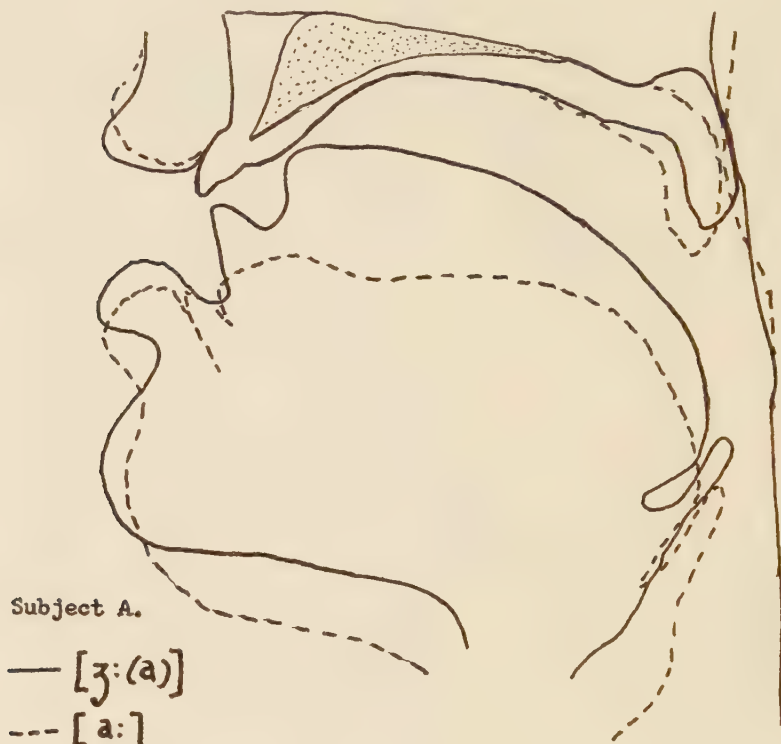


Fig. 37

vicinu [βekinu] > [veʃin] > [vejcin] > [vejtsin] > [vejdzin] > [vojzin] > [vwəzɛ] > [vwazɛ]

pacem [pake] > [paʃe] > [pajce] > [pajtsɛ] > [pajs] > [pɛs] > [pɛ]

placere [plakere] > [plaʃere] > [plajcejr] > [plajtsir] > [plajdzir] > [plezir] > [plezi:r]

[g] INTERVOCALIC FOLLOWED BY [i, e, ɛ].—The postdorso-postpalatal occlusive [g], since it is voiced, is also less tense than its voiceless counter-

part. This relative laxness accounts for two peculiarities in its development: first, the fact that it is more easily, and therefore earlier, pulled forward by the influence of a front vowel following it; second, the fact that it does not proceed so far forward in the course of its development.

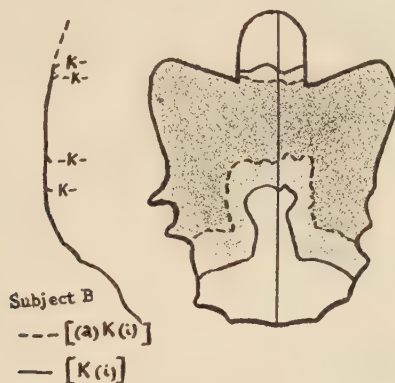


Fig. 38

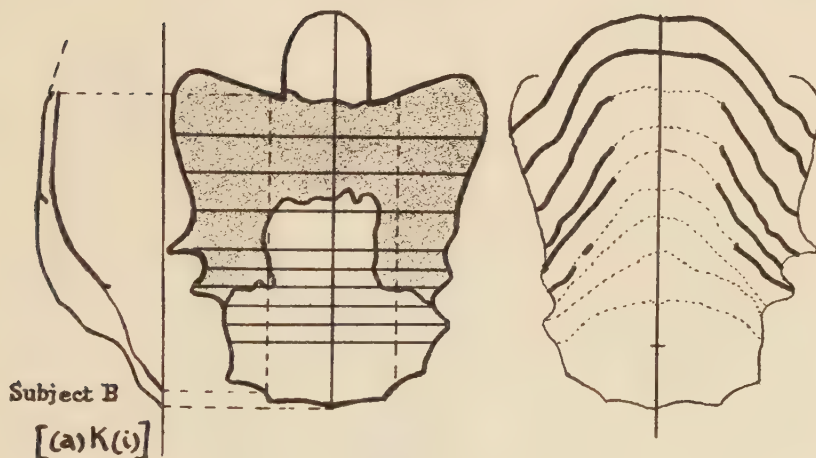


Fig. 39

In Fig. 42 is shown intervocalic [g] followed by [i]. The fronting process consisting largely of a relaxing of activity of the postdorsal region of the tongue, with a shift of tenseness to a region farther front on the palate, reaches eventually the position of [j] shown in Fig. 43.

Whereas the fronting of intervocalic [g] followed by [i] is similar to the fronting of initial [g], the presence of the vowels on either side of the consonant brings about greater opening. The intervocalic consonant is consistently less tense than the initial. Thus the result is not [ʒ] as for [g] in strong position, but [j].

By the time that [g] had become [j], a word like *pagensem* [paʒe:se] was pronounced [pa'jejs]. As usual when a combination [jej] occurs

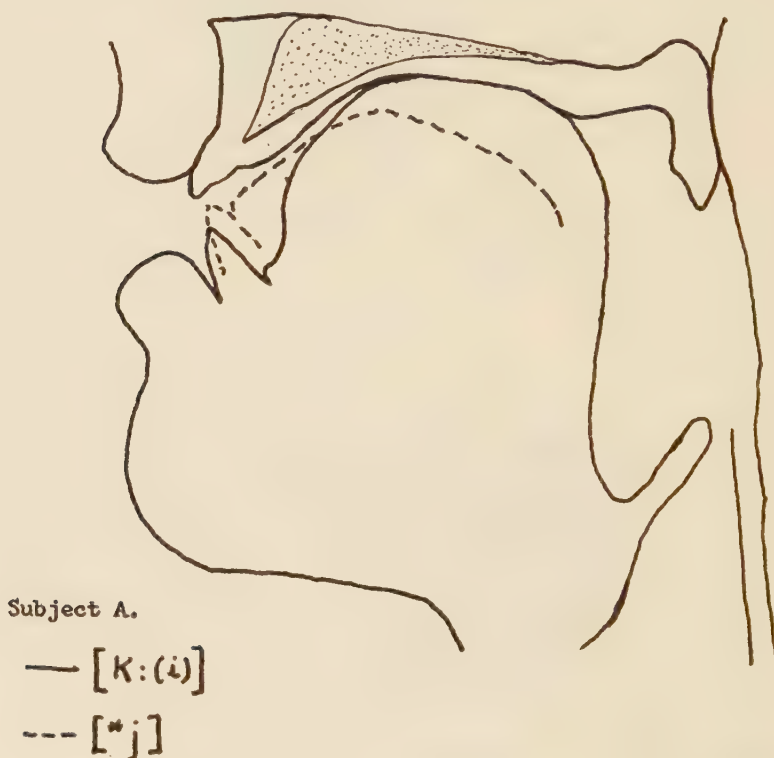


Fig. 40

the resultant simplification is [i]. The tongue assumes a single intermediate position between [j] and [e] (see Fig. 44).

The pronunciation [pajejs] becomes [pajis] in two syllables. The subsequent simplification of all diphthongs into single vowel sounds is essentially a repetition of the same process as demonstrated in Fig. 44. The intermediate tongue position for [e] or [ɛ] is assumed instead of the

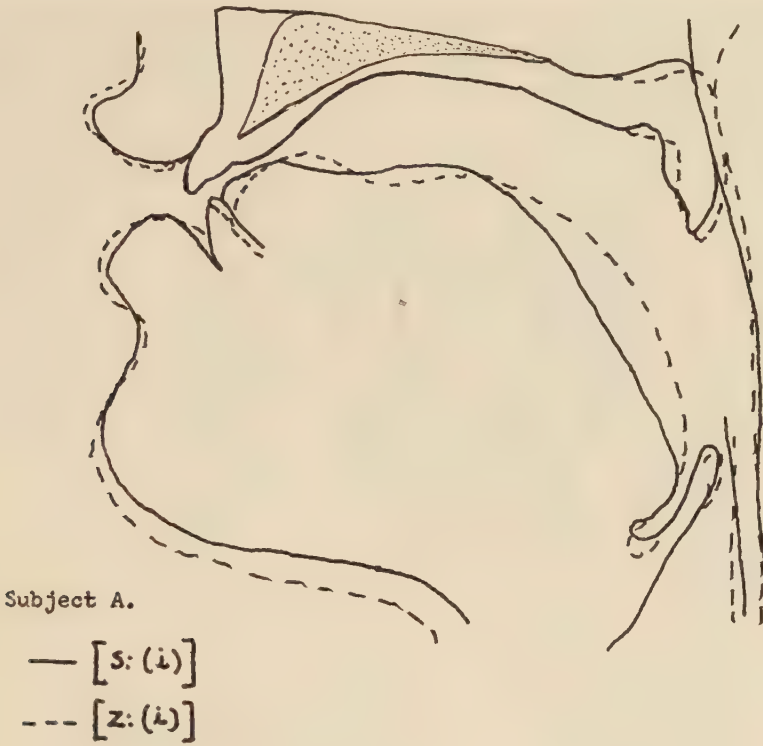


Fig. 41

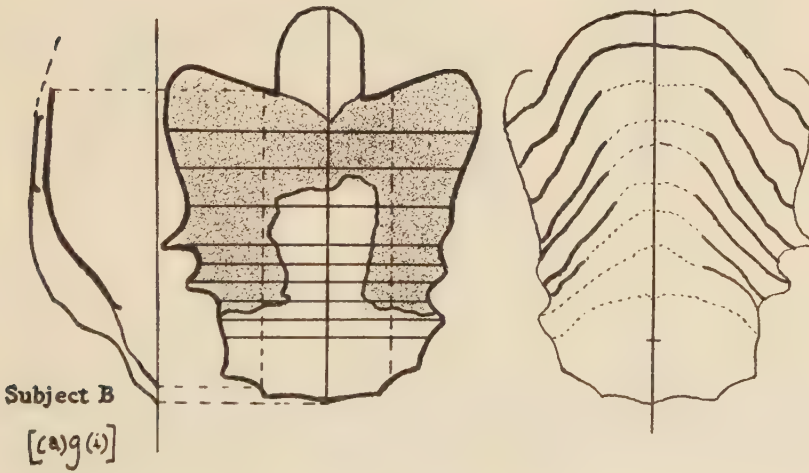


Fig. 42

sequence [ai] (see Fig. 45). Thus we come to the modern stage of the word: [pei]; [i] being a stressed vowel in a separate syllable is not involved in the reduction, and the final [s] is lost along with other finals.

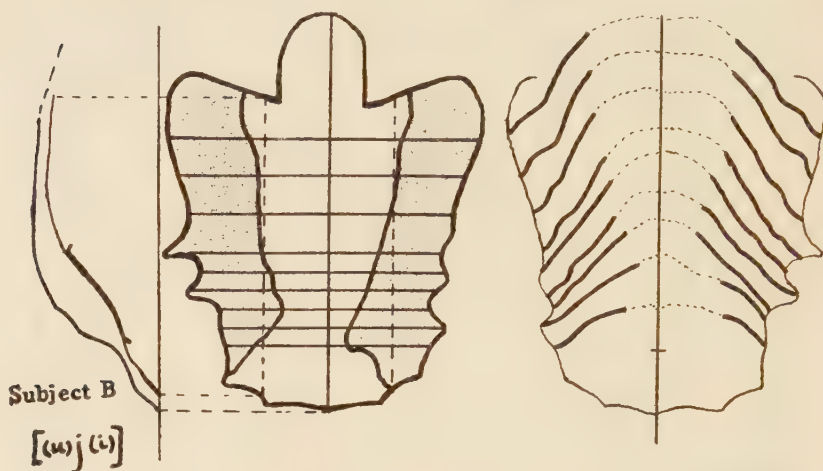


Fig. 43



Fig. 44

[k, g] INTERVOCALIC FOLLOWED BY [a] AND PRECEDED BY A FRONT VOWEL [i, e, ɛ, a].—These can properly be treated together here. The fronting process is similar to that examined in the foregoing section. In Fig. 46, the influence of the front vowel preceding the consonant

[ika] in fronting the occlusion can be seen as compared with [aka] (Fig. 47). A comparison of [aka] with [aga] suggests the relaxation which is the concomitant of voicing.

The consonants [k, g] are not fronted so far when preceding an open vowel as when followed by [i, e] or [ɛ]. The influence of [a] seems to be rather one tending toward opening though not acting against fronting.

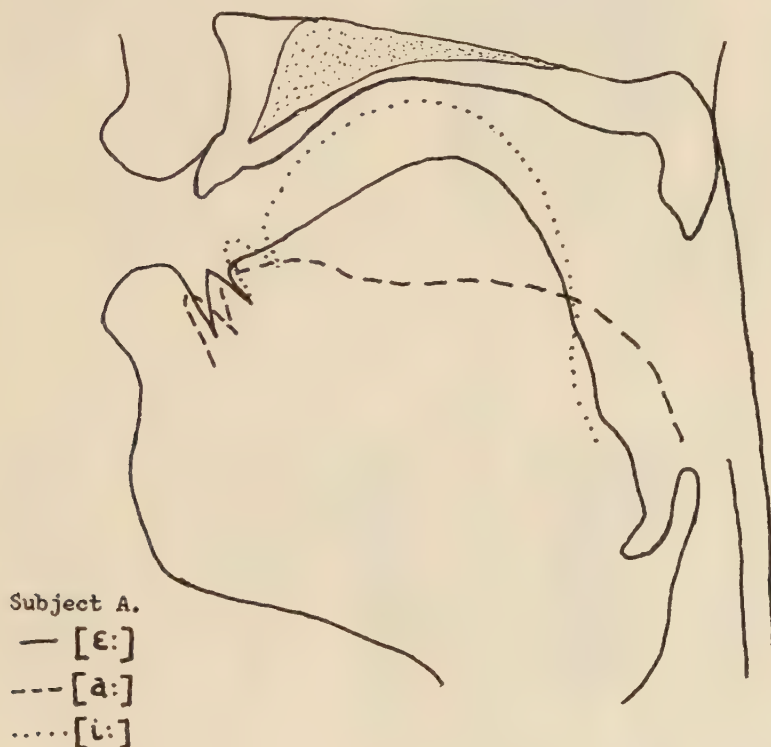


Fig. 45

The graph is complete for [ɛ] only.

Thus the articulation of [j] (Fig. 48) in ModFr. *paya* [peja] is much more open than that noted in the word *bouilli* (Fig. 43).

[kw] AND [gw].—[k] and [g] labialized were not fronted by a following front vowel. In Figs. 51 and 52 appear the palatograms for the combinations [kwi] and [kwan] (*ah qu'oui* and *couenne* respectively). There is no fronting apparent. In Fig. 51 the contact along the sides of the palate is undoubtedly due to the vowel [i].

[k, g] FOLLOWED BY [j].—In strong position the development of the back occlusives before [j] was the same as when they were followed by [i, e, ε] (see pp. 34, 44). The polygrams in Figs. 53 and 54 show [ki]

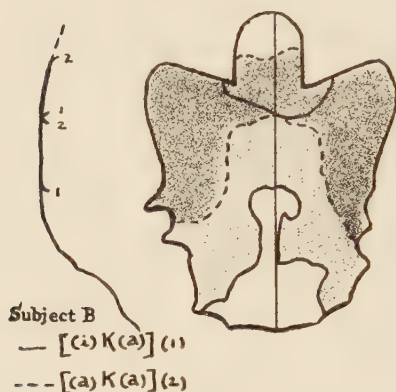


Fig. 46

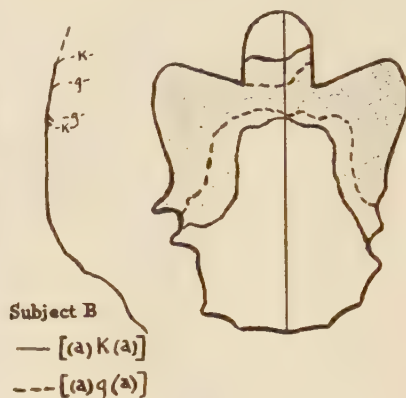


Fig. 47

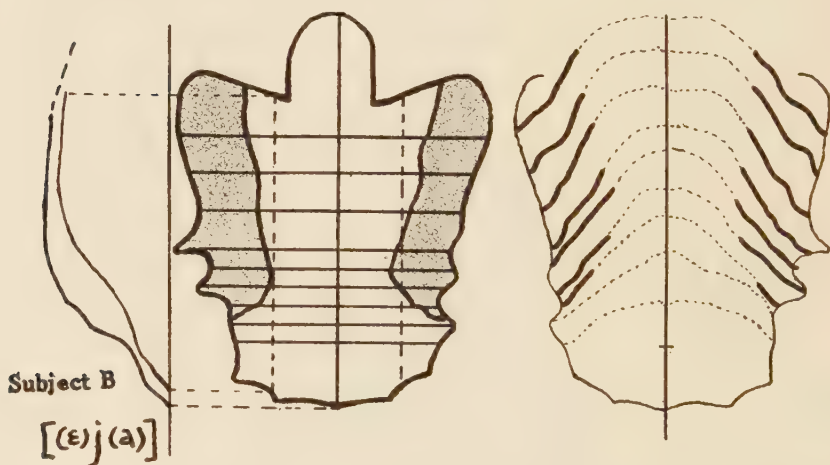


Fig. 48

and [kj], and [gi] and [gj]. In both figures the similarity is apparent between the effect of the front vowel and the effect of [j] on the articulation of the consonants. It is to be noted, however, that in the case of [g] before [j], the accord is greater than in the case of [k] before [j]. The

relative tenseness of the voiceless consonant resists, so to speak, the forward pull of [j] better than the voiced [g]:

arcione [arkjone] > [arʔon] > [arcon] > [artsõn] > [arsõ] > [arsõ]

georgius [gjorgjus] > [ɔrɔðəs] > [ʔorʔə] > [ʒorʒə] > [ʒorʒ]

The combination [kj] between vowels differs in its development from intervocalic [k] followed by [i, e, ɛ] (pp. 49-52). Whereas the ultimate

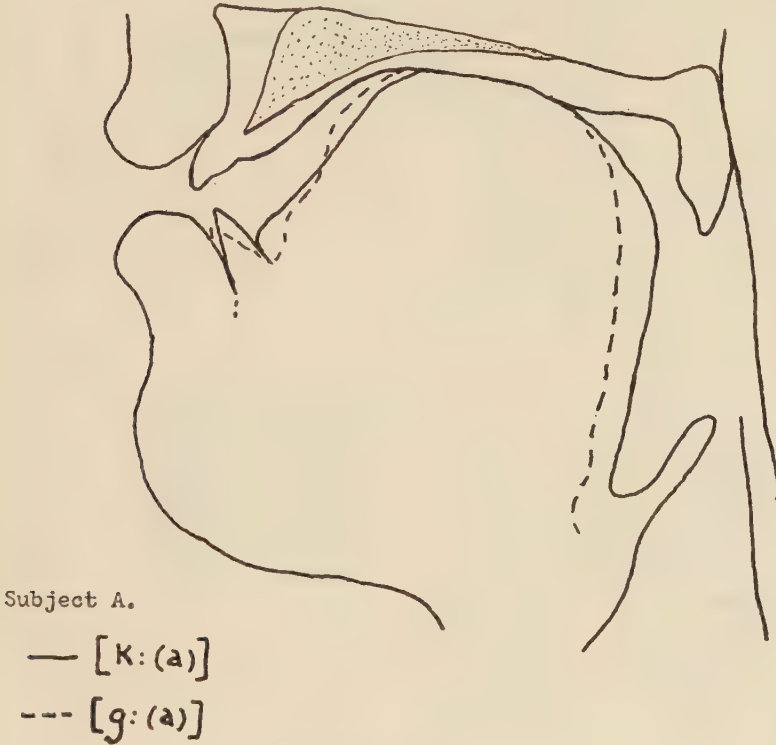


Fig. 49

Complete graph for [k:a]. For [g:a] tongue outline only.

result of this latter development was [z] with a vocalic [j] element arising before it and combined with the preceding vowel, [kj] remains voiceless. The fronting process is the same, but the affricate stages seem to have been prolonged articulations (cf. Fig. 17). Such a prolonged closure when it occurs is essentially evidence of resistance to the two tendencies

affecting all intervocalics more or less: voicing; relaxing or opening. The presence of two elements in the group [kj], each of which is closer (more tense) than the vowel on either side of it, may be thought of as the reason for the prolonged articulation which prevented voicing: [kj] > [k̄ç] > [t̄:] > [c:] > [ts:]

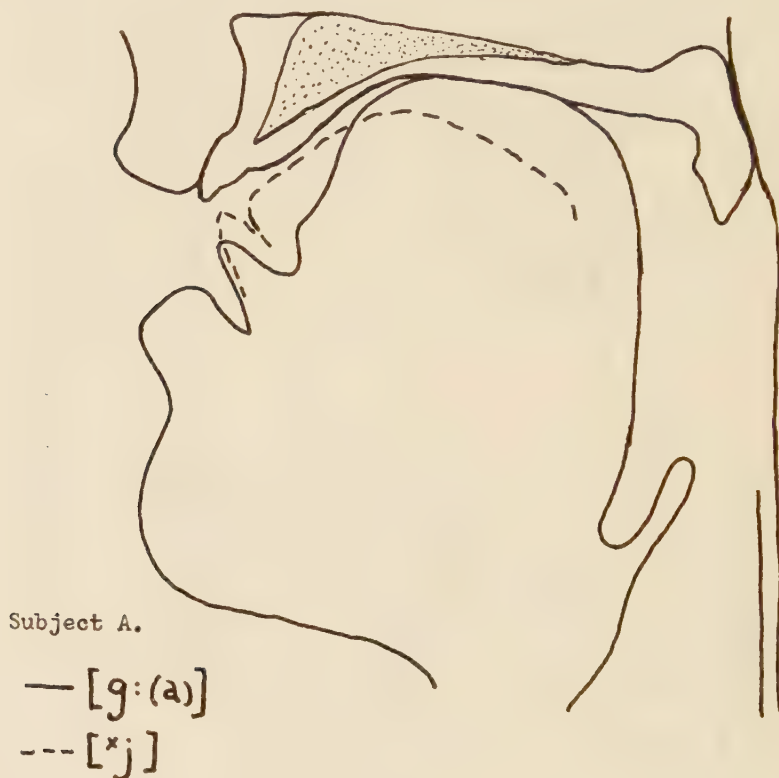


Fig. 50
Complete graph for [g:a].

The group [gj] between vowels being voiced is more easily opened to [j] and combined into diphthong with a neighboring vowel. These diphthongs simplify to single vowel-sounds, in the later medieval period (cf. p. 57).

When [kj] became final through the loss of posttonic vowels, the articulation [s] in weak position was lost according to the principles operative at a relatively late period (see Loss of Consonants, pp. 106-9).

faciam [fakja] > [faʔ:v] > [fac:ə] > [fats:ə] > [fatsə] > [fas(ə)]
brachium [brakju] > [braʔ:o] > [brac] > [brats] > [bras] > [bra, bra]
corrigiam [kor:egja] > [kor:ejv] > [koroj(ə)] > [kurwɛ] > [kurwa]

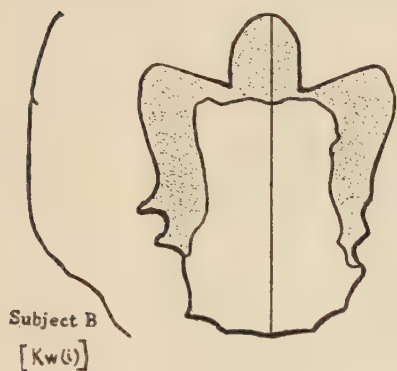


Fig. 51

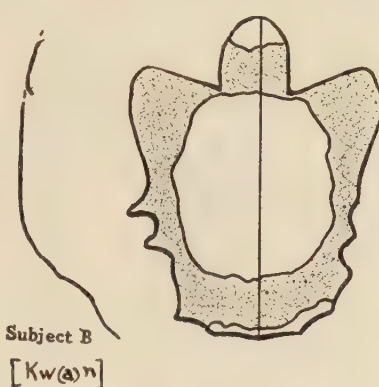


Fig. 52

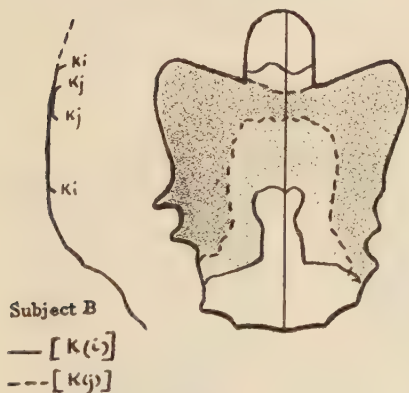


Fig. 53

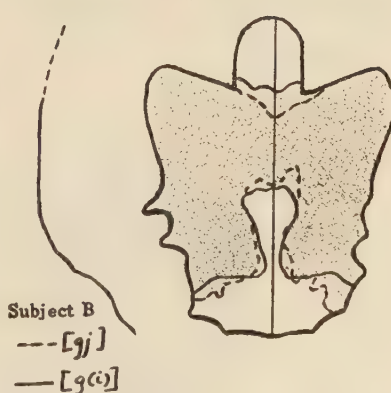


Fig. 54

BACK CONSONANTS IN WEAK POSITION

[k, g] IN WEAK POSITION, FOLLOWED BY [t, d].—The fronting of back occlusives in weak position by the influence of front consonants immediately following, which takes place in the development from Latin to French, is not clearly noticeable in Modern French articulations. In Fig. 55 appears the palatogram of [aku]. We may consider the area of contact as representative of the non-fronted [k].

The palatogram for the combination [k + t] compared with [k + u] (Fig. 57) shows a certain fronting, but not as great as in [k + i] or [k + a]. However, there is probably a more pertinent comparison in Fig. 59, [k] final compared with the arresting consonant in this combination.

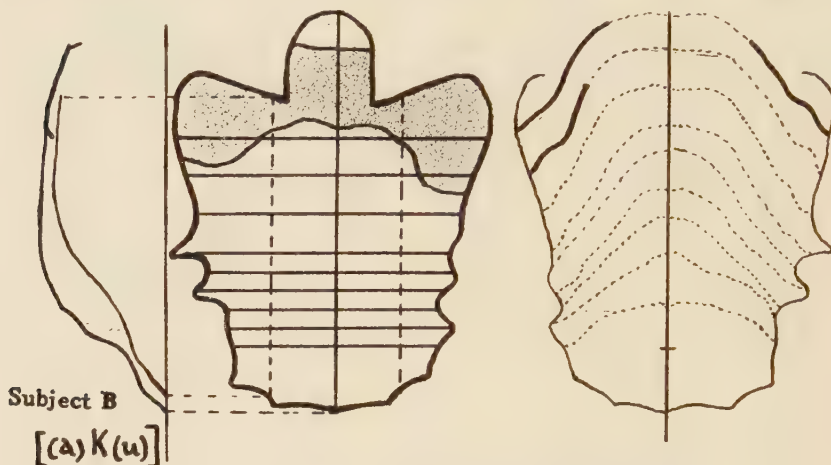


Fig. 55

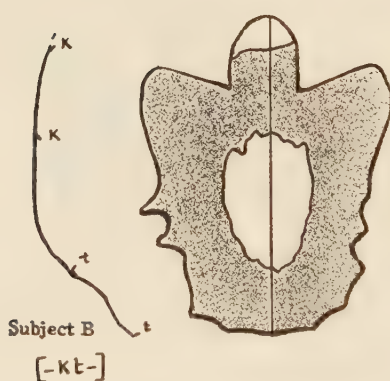


Fig. 56

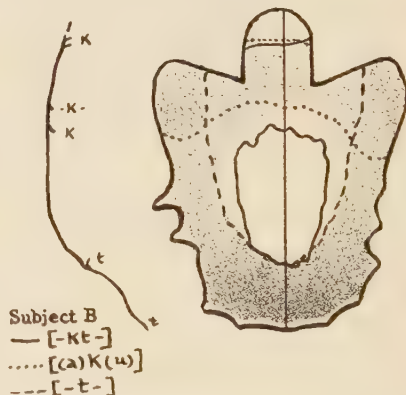


Fig. 57

The vowel preceding the arresting is in both cases [a]. From this polygram (Fig. 59), it is noticeable that final [k] is fronted farther than the back occlusive in the consonant group. This may be due to the fact that the final arrests a stressed syllable. In the development of this group, such a fronting of the arresting consonant is assumed.

In Fig. 58 is shown a comparison of [k + t] with [t + j]. Since no palatogram was available of the combination [j + t], this palatogram is only indicative of the spread of the tongue in a combination of [j] and [t] in strong position. In Fig. 57 may be seen the relationship between [-kt-] and [t-] in strong position. Fig. 58 shows one interesting point, however: the close correspondence in area of contact along the sides

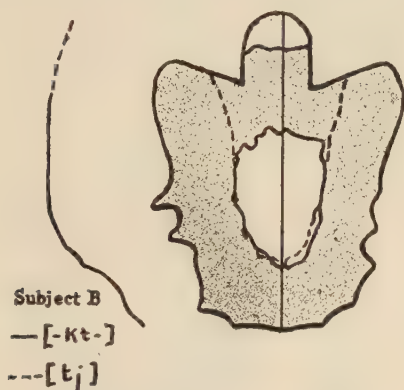


Fig. 58

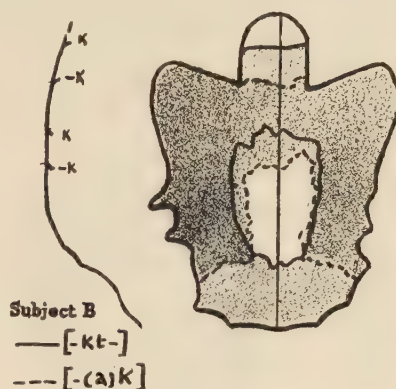


Fig. 59

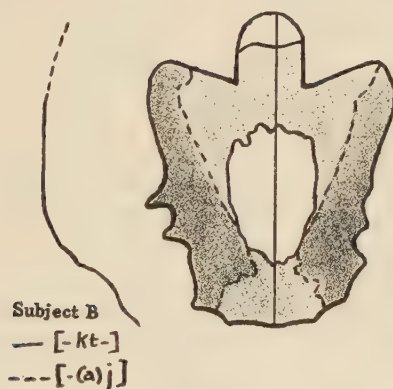


Fig. 60

of the palate. From this palatogram can be imagined the nature of the articulation, when the closure of the weak [k] had been relaxed, whether it became first the voiceless [ç] or was voiced as it was relaxed, to [j].

The comparison between [j] in final position and [-kt-] can be made by examining Fig. 60. Here again the vowel preceding the arresting [j] was [a].

From these polygrams, fragmentary though they be, some visualization may be gained of the processes involved in the development of Latin *factum* > *fait*.

factum [faktu] > [façt] > [fajt] > [fet] > [fe]

An entirely parallel course was followed by the voiced counterpart of this group, namely [-gd-] (Fig. 61). The relative instability of the voiced consonant, even in strong position, as compared with [t] in [-kt-], is seen here in that there is some tendency apparent to move the closure back, at the sides, from a dental to a gingival region of contact. Fig. 62 shows [d-] in strong position compared with [-gd-].

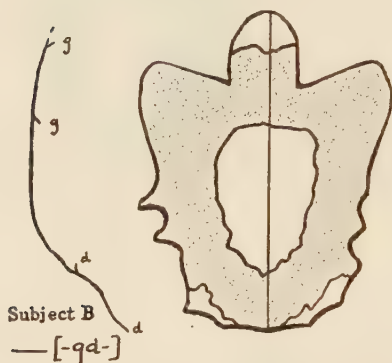


Fig. 61

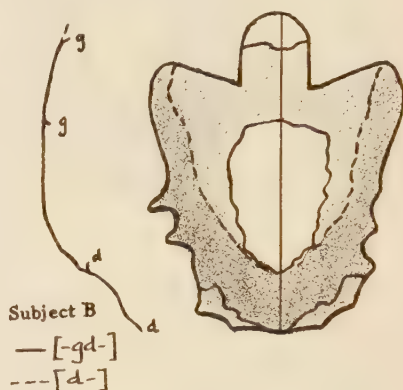


Fig. 62

Final [-g] compared with [-gd-] suggests the fronting and relaxing processes which took place. In Fig. 64 final arresting [j] is shown in conjunction with [-gd-].

rigida [regda] > [rejda] > [reida] > [roida] > [rwəda] > [rwad, rəd]

[k] IN WEAK POSITION FOLLOWED BY [s].—The combination [-ks-] shown in Fig. 65 is characterized by a slight fronting of [k] as compared with the non-fronted [k] contact (dotted line in Fig. 65). But this fronting is less marked than for the back occlusive in the combination [-kt-]. It may be concluded that the [t] being articulated farther forward than [s] is responsible for this greater fronting of the weak [k] preceding it. A further noticeable fact is the influence of [k] upon [s], retracting its zone of articulation slightly. (In Fig. 65 the broken line marks off the area for [-s-]). It must not be thought that this [s] retracted by the influence of the back consonant is something like a [ʃ]. The polygram in Fig. 66 shows the difference, and acoustically the effect

is that of [s]. The tongue as a whole rises much less for the [ʃ], and is farther back than [s]. The palatogram of [ʃ] used in Fig. 66 is that of the initial in [ʃa].

In the development of [ks] (Latin *x*), the back closure of the weak arresting consonant was relaxed as it was fronted: [laksare] > [laçsar] or [lajsar]. But the retraction of the [s], and particularly the spread of the

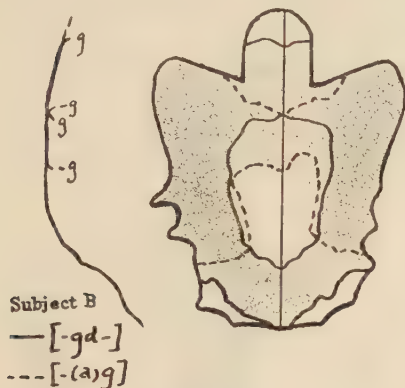


Fig. 63

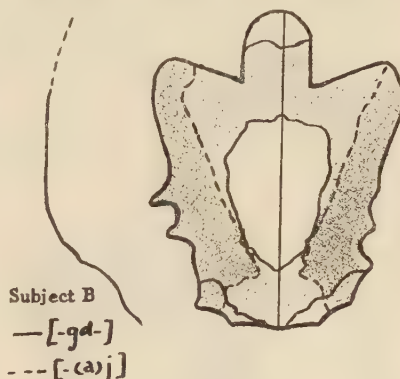


Fig. 64

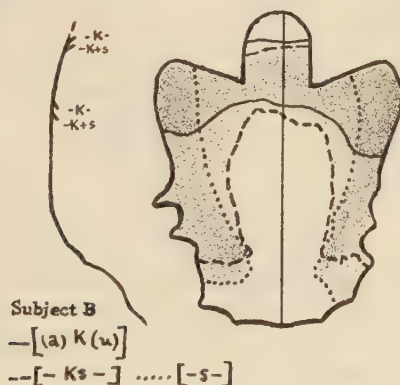


Fig. 65

tongue on either side of the palate then gave rise, at least before [a], to an articulation which must have sounded like [sj], hence the spelling *-si-*. Note in Fig. 67 the correspondence between the front part of the area for [-ks-] outlined by the full line, and the area for the combination [-sj-] outlined by dots. The broken line marks off the area belonging to [-j].

Thus the palatogram for Modern French [-ks] shows in embryo the steps involved in the development of Latin *laxare*:

[laksare] > [laçsar, lajsar] > [lajsjər] > [ləsjər] > [lese]

Possibly a more accurate transcription of the last two stages may be given, since it is doubtful that there was actually a lost semi-consonant [j]. It is more likely that the spelling in the form *laissier* represents a retracted, prepalatal [s], and that this was assimilated to the normal [s], thereby occasioning a revision in the spelling.

laxare [laksare] > [laçsar, lajsar (with retracted s-)] > [lajs-ɹər] > [ləsər] > [lese]

[k, g] FOLLOWED BY [r].—The evolution of the consonant combinations [-kr-] and [-gr-] can properly be considered together since the

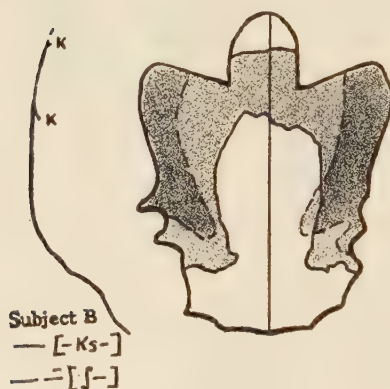


Fig. 66

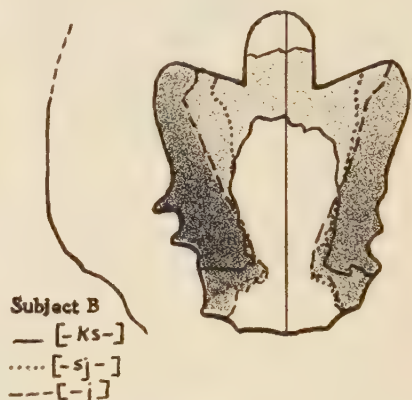


Fig. 67

voiceless occlusive between vowel and [r] was doubtless voiced early. This assumption is based upon the great stability in the development of [r] in the Romance languages, which in turn argues for an energetic articulation in Latin. These consonant groups develop as having the occlusives arresting, therefore weak consonants, the [r] being a releasing, strong consonant, comparable then to the initial. It is safe to assume that the initial [r] in Latin was a strongly articulated, prolonged trill, like its modern derivative in Spanish, in Portuguese, and frequently in Italian. Another argument in favor of a 'multiple' trill [r:] in this position is the very fact that when such an [r] is pronounced, the occlusive preceding it is necessarily detached from it, belonging then to the preceding syllable and arresting it. In this position the voiceless occlusive [k] would tend to voice as between vowels. Hence we assume pronunciations [sagramentu, 'lagrema] for *sacramentum*, *lacrimam* at a

relatively early date. These cases are then comparable to (*fragrare*) **flagrare* [flagrare].

Unfortunately the palatograms in Figs. 68 and 69 showing [-kr-] and [-gr-] respectively throw little light on this development because Subject B did not possess the tongue-tip trilled [r]. He was asked to imitate an Italian's pronunciation of the syllables [kra] and [gra]. In the second

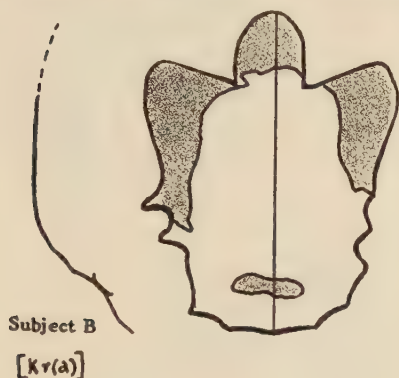


Fig. 68

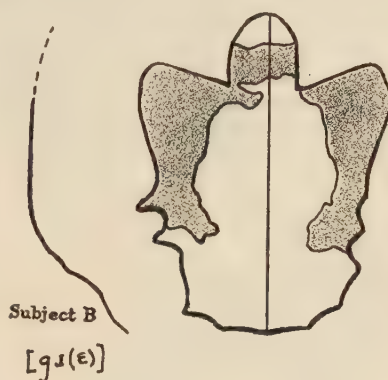


Fig. 69

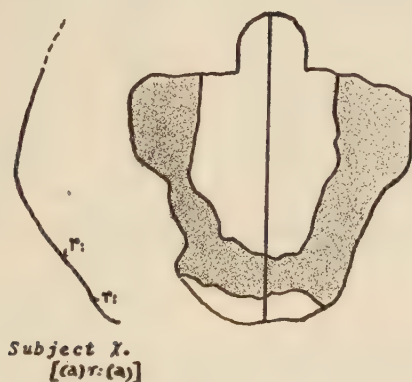


Fig. 70

case it is clear that the second consonant in the group was an American type constrictive fricative [ɹ]. Fig. 70 gives an example of the articulation [r:] of Subject X.

From the palatogram for final [-(a)g] in Fig. 71 may be seen the progress of the occlusive in these consonant groups (full line). There is here a noticeable weakening, as it were, along the median line, as the contact is moved forward. Further relaxation by tongue-inertia brings

about the complete absence of contact across the median. In Fig. 71 may be seen the comparison between arresting [- (a)g] and [-j-]: Fig. 72 shows [- (a)g] and [- (a)j]. This is the end of the consonantal develop-

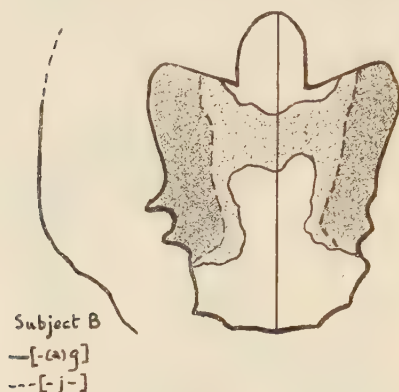


Fig. 71

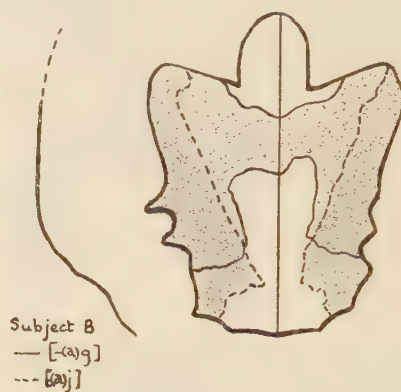


Fig. 72

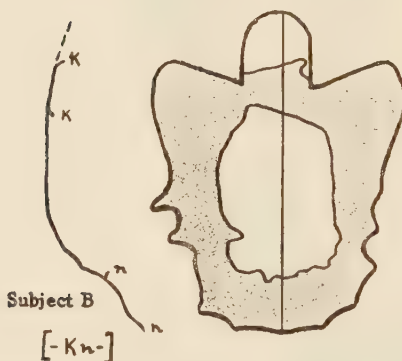


Fig. 73

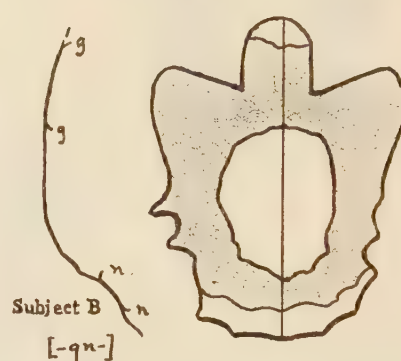


Fig. 74

ment. Thenceforth the [j] exerts a lifting influence upon the preceding vowel or combines with it: [a + j] > [ɛ], etc. (cf. Fig. 45).

lacrimam ['lakrima] > ['lagremə] > [laɹmə] > [lərmə] > [laɹm]

flagrare [flagrare] > [flaɹrar] > [flerər] > [flere] > [flere]

[k], [g] FOLLOWED BY [n].—Although the palatograms in Figs. 73 and 74, showing [-kn-]⁸ and [-gn-] respectively, give little evidence of the

⁸ The instances of Latin -cn- [-kn-] coming down into French are rare, and not absolutely clear. This consonant group is shown here for the sake of completeness.

processes which occurred in the evolution of these two groups, there is the usual demonstration of the voiced [g] being more fronted than [k].

In French, during a period of its earlier development, there has been a strong tendency to anticipate nasality: all the nasal vowels of Modern French result from such anticipation. In these consonant groups also, where [k] and [g] are weak, arresting consonants, it is safe to assume that they became nasalized by anticipation of the [n] immediately following. For [k] this would mean voicing as well, since nasal sounds, in French at least, are voiced. In Fig. 75 final [k] is compared with [ŋ]. The distance to be traversed in the process of voicing can be seen by comparing Fig. 75 with Fig. 76. In the latter, final [-g] is graphed with [ŋ] and the coincidence of the two outlines is remarkable.

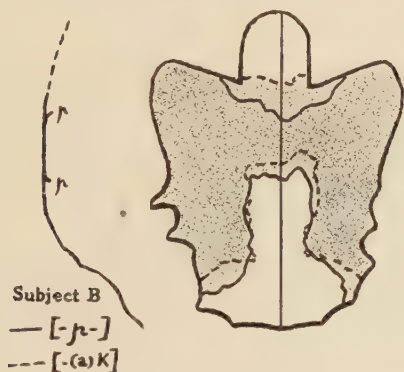


Fig. 75

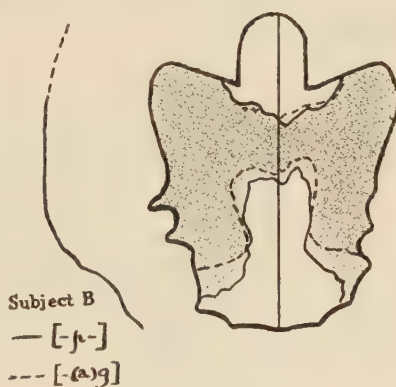


Fig. 76

This stage in the development of the back consonant may be transcribed thus:

agnellu [agnel:ʊ] > [aŋnel]

pugnu [pogno] > [poŋn]

The influence of the front (gingival) [n] is operative to cause the release of [ŋ] to be made forward. The zone of contact for [ŋ] may be postpalatal, as is shown in Figs. 75, 76, 77. In the radiograph of Fig. 78 the contact extends forward to include the prepalatal region also. This is perhaps not an altogether abnormal spread.⁹ The postpalatal contact with median release is acoustically the same as the articulation in which the contact is made against the prepalatal region as well.

⁹ Cf. the palatogram for Spanish ñ in T. Navarro Tomás, *Manual de Pronunciación española*⁴ 132 (Madrid, 1932).

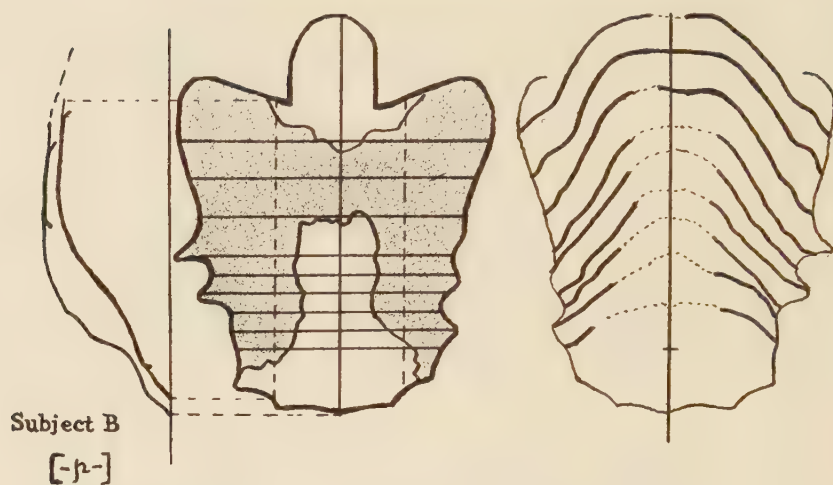


Fig. 77

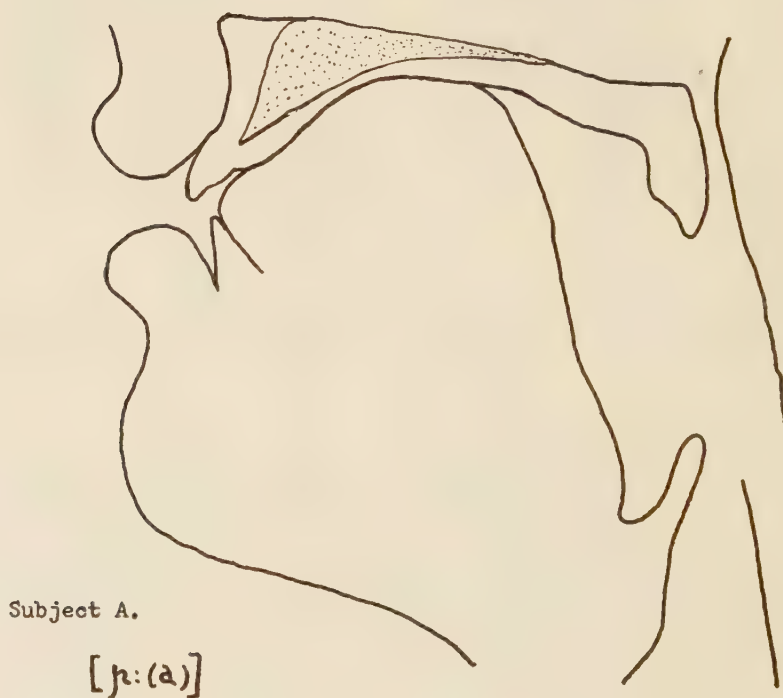


Fig. 78

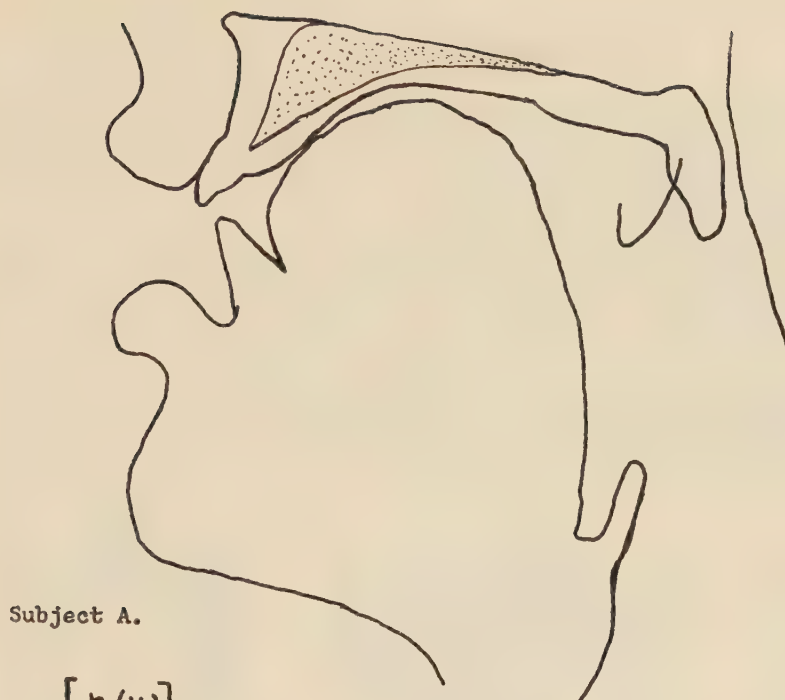


Fig. 79

The exposure for this radiograph was accidentally made too late. The picture is interesting in that it shows that the direction of the release (even though the vowel following is [u]) is forward, or at least that the pre-dorsal region leaves its contact with the palate later than the posterior region of the tongue.

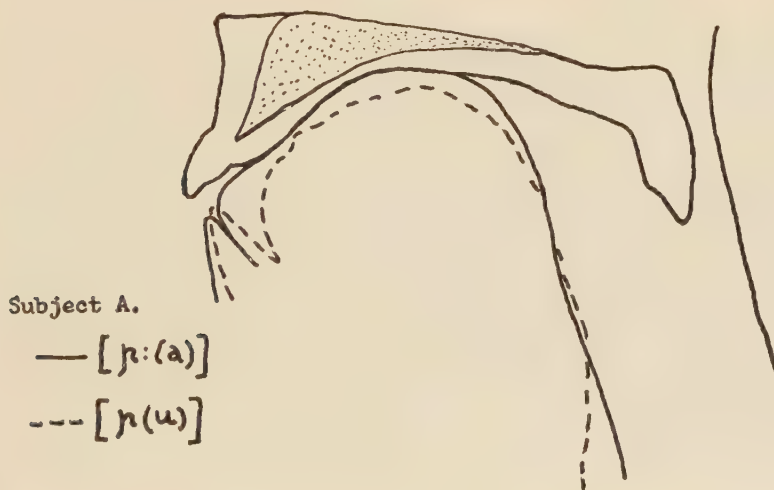


Fig. 80

When [ɲ] became final an on-glide [j] developed and later combined into a diphthong with the preceding vowel.

The radiograph for [ɲ:(i)] shows a contact identical in area and position with that for [ɲ:(a)]

To complete these developments:

agnellu [agnel:ʊ] > [aɲnel] > [aɲnel]¹⁰ > [aɲel] > [aɲeau] > [ano]

pugnu [pogno] > [poɲn] > [poɲɲ] > [poɲɲ] > [poi(n)] > [pwē]

BACK CONSONANTS IN RELEASING CONSONANT GROUP

[k, g] FOLLOWED BY [l].—The back occlusives in initial position followed by [l] undergo no change from Latin to French.¹¹ This is also true when these groups are preceded by another consonant. They are

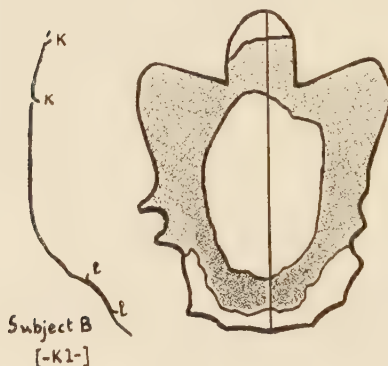


Fig. 81

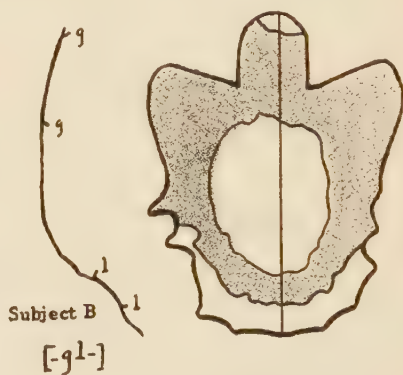


Fig. 82

for the most part secondary developments, i.e. after an intertonic or post-tonic short vowel has dropped, are brought into contiguity with [l]:¹²

circulum [k̄erklu] > [t̄erklo] > [cerklə] > [tserklə] > s̄erkl(ə)]

When preceded by a vowel [kl] and [gl] accord as to position, the velar occlusives being fronted and the [l] pulled back. Figs. 81 and 82

¹⁰ A variant simplification took place in Middle French: [-ɲn-] > [-n-], *agneau* [ano], *signet* [sine] through the 17th century (see Bourciez, *Précis historique de phonétique française*⁶ 179 [Paris, 1926]).

¹¹ A number of instances of Latin *cl-* becoming *gl-* in French remain unexplained: *glaire* < *claria*, *glas* < *classicum*? O. Bloch and W. von Wartburg, *Dictionnaire étymologique de la langue française* 1.337 (Paris: Presses universitaires, 1932).

¹² The combination *-sc'l-* seems to have been simplified early to *-s'l-*: *masculu* [masklo] > [maslo] > [ma:l] (cf. [-stj-] > [-sj-] p. 42 above).

showing palatograms of [-kl-] and [-gl-] respectively give little evidence of these two processes.

It is noteworthy, however, that [g] is farther front than [k] in these combinations. This may be taken as an indication that the fronting of [k] was accompanied by voicing; there is no possibility of stating whether the voicing or the fronting took place earlier. The two phenomena are most probably concurrent. Already by the end of the 8th century there are transcriptions which suggest the presence of [j] as the outcome of [k] and [g] between a vowel and [l].

In Fig. 83 is shown the palatogram of [ʎ] by Subject X.¹³ The considerable spread of the tongue against the palate includes the regions of [l] and of a fronted [k] or [g]. The tenue of this articulation is similar

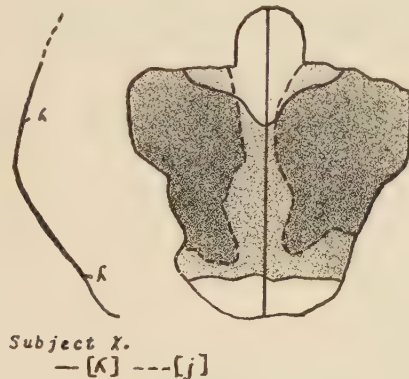


Fig. 83

in acoustic effect to that of [l], and the tension and détente, particularly if slowly produced, resemble the sound of [j] which results from a fronted and relaxed [g].

In these consonant groups in Latin, it is a question, not of arresting plus releasing consonants, but of releasing groups, as in Modern French (see pp. 16, 22 above). When these groups occurred after the stressed vowel, the stressed [ɛ] and [ɔ] diphthongized respectively to [jɛ] and [wɔ], before the fusion of the two elements of the group into [ʎ]. According to Bourciez,¹⁴ these diphthongizations were completed by the 6th century. Thus no checking influence, as of an arresting consonant, is present in the development of *vetulu* [βɛklo] > *vieil* [vjɛjʎ]; *oculu*

¹³ Cf. T. Navarro Tomás, *op. cit.* 133.

¹⁴ *Op. cit.* 63, 92.

[ɔklo] > *ueil* [wejɛ]. There is a checking influence, however, exerted by [ɛ] once it has developed (by the 9th century), since preceding it [a] does not become [ɛ, e], nor does [ej] < [e] follow the usual development to [oi, wɛ, wa]. These vocalic changes took place respectively in the 9th and the 12th centuries.

How this [ɛ] checks the preceding vowel needs some explanation. Possibly [ɛ], an articulation which requires a somewhat longer time than an ordinary single consonant, has an influence similar to that of double consonants, which are actually prolonged consonants. Just as *caballu* [kabal:ʊ] > [ʃəval] and *terra* [tɛr:a] > [tɛ:r] without change of the checked stressed vowel, so also then *macula* [makla] > [majɛ] > [maɛ:] > [ma:j, ma:] not [*mɛ:j].

The relaxing of [ɛ] to [j] in most regions of France is a relatively modern phenomenon, attested since the middle of the 17th century (see p. 86 below).

oculu [ɔklʊ] > [wɔglo] > [wejɛ] > [wɛɛ:] > [œɛ] > [œ:j]

coagulare [kwaglare] > [kwaglar] > [kajɛr] > [kaɛ] > [kaje, kaje]

CHAPTER IV

THE INFLUENCE OF [j] OTHER THAN FRONTING

The influence of [j] upon preceding consonants, whether dental or alveolar, occlusive or constrictive, was invariably to pull back the region of articulation, usually causing greater contact between tongue and palate.

DENTAL CONSONANTS IN STRONG POSITION

[tj] AND [dj] IN STRONG POSITION.—In Latin only dental occlusives plus [j] occur in strong position. In Fig. 84 [tj] is shown. In the next figure (85), the polygram of [t] and [tj] compared brings out the following points: the influence of [j] is not to pull back the zone of occlusion, but to increase the area of contact between tongue and palate (note the depth-diagram in Fig. 84). This area does not represent simply the contact of [j] following the occlusive. The polygrams in Figs. 86 to 89 inclusive show that [j] alone, whether initial, intervocalic, or final, has no such spread, except in the case of [-j-] between [u] and [i] in the word *bouilli* (Fig. 89). The high vowels here cause a high position for [j] also, which shows up as a contact against the palate not unlike that for [tj]. The constriction of [j] adapts itself to the contiguous articulation, becoming greater as the contiguous sounds are more close.

Doubtless the voicelessness of [t] spread to [j] in this combination and resulted in [tç], a process which can be observed, in modern pronunciation also. The two articulations then fused into one [tʃ], which, by shifting the zone of tension to prepalatal, brings about a break in the dental contact (see Figs. 17, 18). Although the palatogram of [tj] shows no lack of dental contact, there is evidence¹ that the assimilated articulation [ts] (which this combination reached in OFr.) is gingival and not dental. From the stage of [tʃ], as in the case of fronted [k] in strong position (see pp. 34-43 above), the usual progress to [c] > [ts] > [s] is made (Fig. 90).

cantione [kantjone] > [kancon] > [cāntsōn] > [fāsō]

The development of [dj] in strong position falls in, at a very early

¹ In a study of Franco-Canadian articulation which the author is preparing, this evidence will appear.

date, with the development of [g] in strong position fronted by a front vowel or by [j]. In Fig. 91 appears the palatogram for [d-], and this is compared with [dj-] in the polygram of Fig. 92. This latter is enlightening as to the effect of the constrictive upon the occlusive element in the

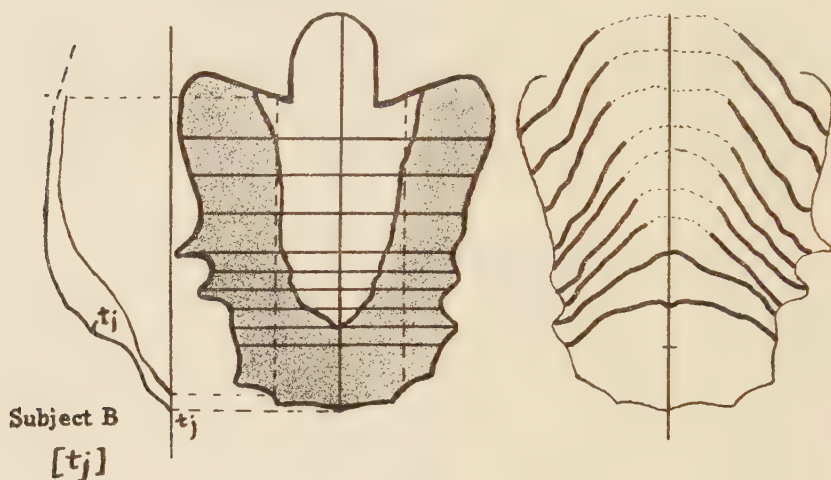


Fig. 84

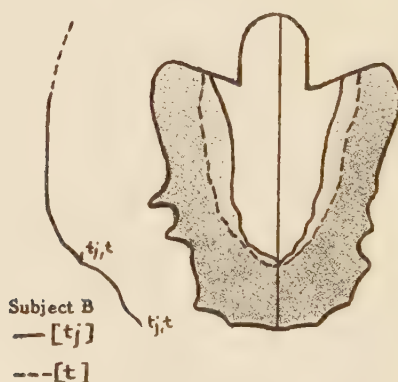


Fig. 85

combination: not only is the zone of occlusion retracted from denti-lingival to gingival, but it is reduced in its area. This latter fact is perhaps the most important of the effects of the combination. It means, by implication, that the focus, so to speak, of the articulation

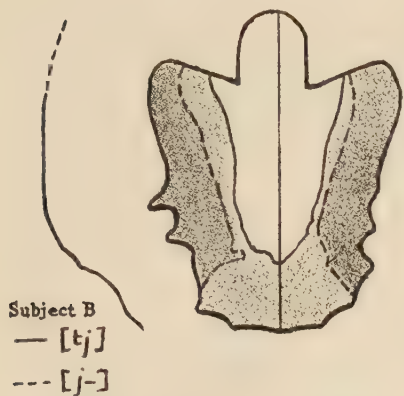


Fig. 86

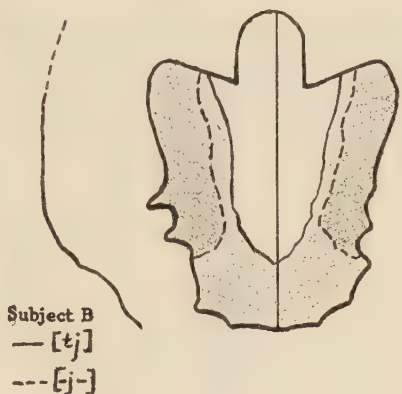


Fig. 87

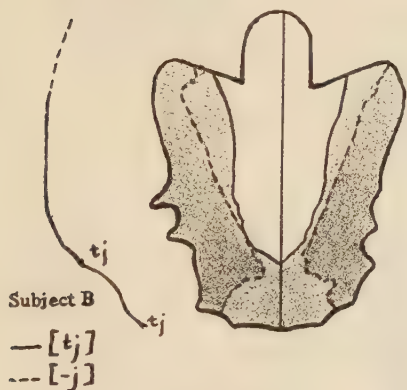


Fig. 88

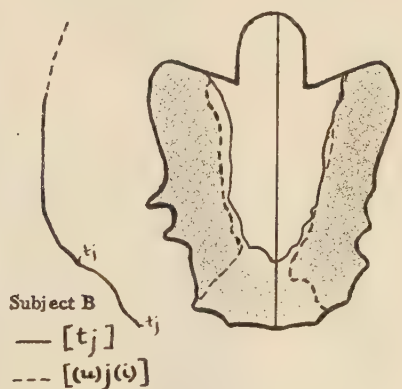


Fig. 89

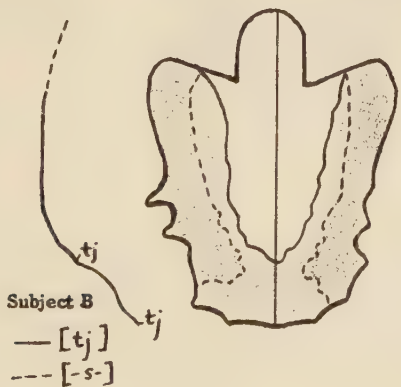


Fig. 90

is no longer dental or gingival but prepalatal or even midpalatal, as evidenced by the greater spread of the tongue against the palate in the latter region. There is a kind of compensation: as the tenseness increases in the midpalatal region, it decreases in the dental region, the

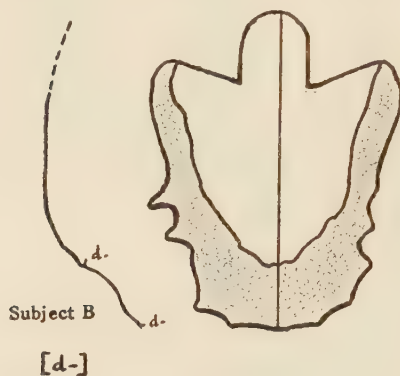


Fig. 91

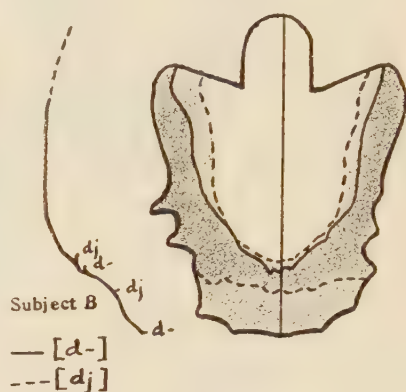


Fig. 92

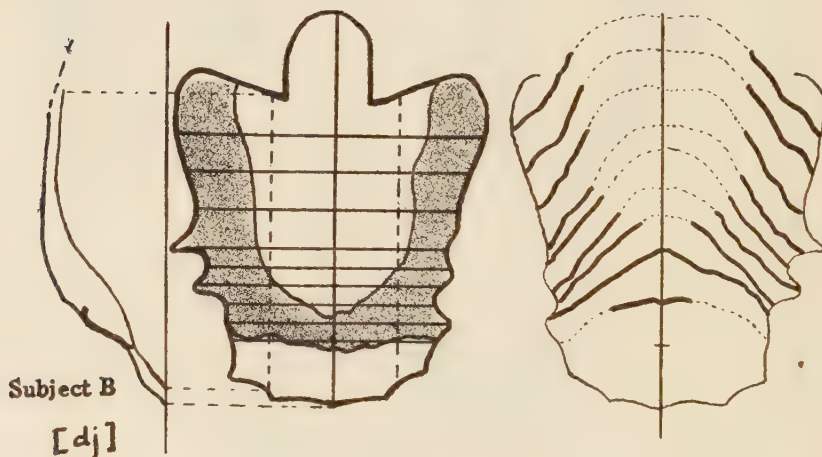


Fig. 93

voiced (lax) [d] not having sufficient tenseness to resist this shift, as [t] is able to do. It is clear that when the shift backward is complete there is what may be called a fusion of the two elements into one articulation [ɖ]. In passing from this articulation [ɖ] to that of [j], there is only a

very slight shift in the zone of occlusion, but the sides of the tongue show narrower areas of contact on each side of the palate (see Figs. 31, 32).

A relaxing of the articulation results in the failure to make the occlusion complete: [j] becomes then the constrictive [ʒ]. In Fig. 94 is shown [dj-] compared with [ʒ], the result of the development in Modern French.

diurnu [djorno] > [ɔorno] > [ʒor(n)] > [ʒuːR]

DENTAL CONSONANTS BETWEEN VOWELS

[tj] AND [dj] INTERVOCALIC.—Between vowels the voiceless dental occlusive [t] followed by [j] underwent a development similar to that of

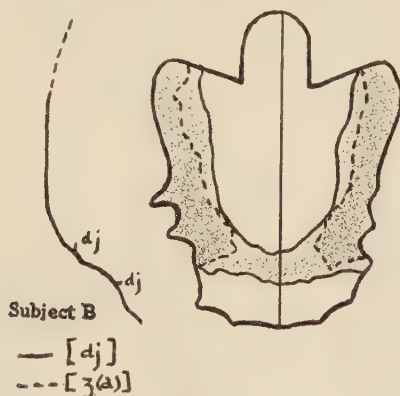


Fig. 94

[tj] in strong position. When the stage of [c] had been reached, an on-glide [j] developed before it (cf. [k + i, e, ɛ] intervocalic, p. 49). At the stage [ts] if this articulation was still intervocalic it voiced and relaxed to [dz], subsequently simplifying to [z]. If, through loss of posttonic vowels, [ts] was final, it simplified to [s] without voicing.

ratione [raʔon] > [rajcōn] > [rajtsōn] > [rajdzōn] > [rɛ(j)zō]

palatiu [palaʔo] > [palaɛ] > [palajts] > [pale(j)s] > [pale]

The voiced [d] followed by [j] between vowels, being lax, was opened very early to [j] (cf. [gj], p. 60). If it remained intervocalic it persisted as [j] fricative, though the preceding vowel was affected by its presence (Fig. 96). When secondarily final it combined with the preceding vowel into a diphthong which simplified along with other monophthongizations.

modiolu [modjəlʊ] > [mojwəl] > [mojwɛl] > [mojeʊ] > [mwejø] > [mwajø]
radiu [radjʊ] > [raj] > [rɛ(j)] > [rɛ]

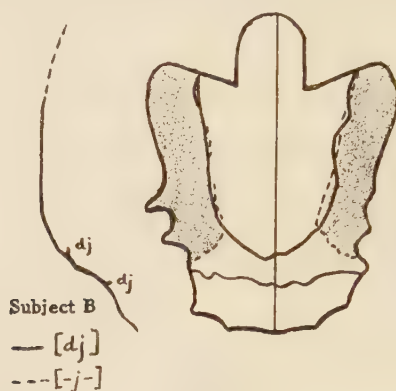


Fig. 95

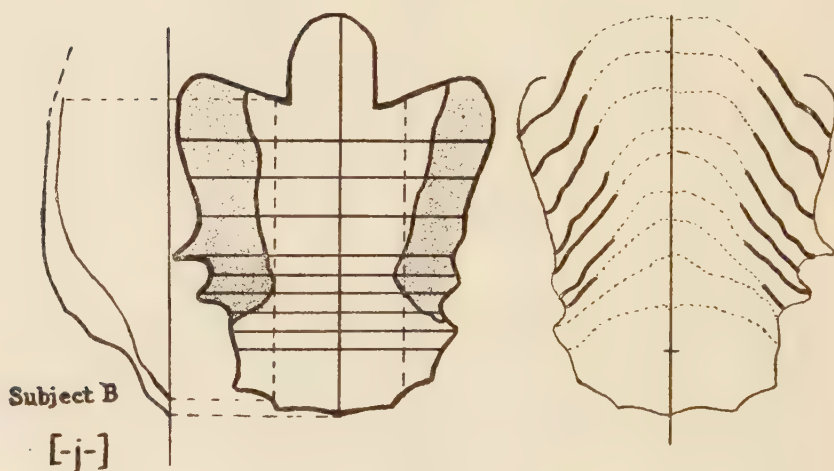


Fig. 96

[n] INFLUENCED BY [j]

[nj] > [ɲ].—In Fig. 98 the separate articulations [-n-] and [j-] in strong position have been superposed. The initial [j-] was chosen because it represents a relatively tense articulation of this sound which

shows marked variations in its spread against the palate (see Figs. 86 to 89). The shaded portion in this composite represents the maximum contact; each of the component articulations is outlined. Compared with the palatogram for [nj] occurring in the body of a word, the composite does not show as great an area of contact (Fig. 101). There is mutual influence between [n] and [j]: the zone of occlusion of [n] is spread forward and backward; the contact along the sides of the palate is increased, greater not only than that for [-n-] but even for [j-].

Physiologically these effects may be expressed thus: in the combination [nj] the tongue tip touches the alveolar ridge, then, upon releasing this contact, moves down toward the lower incisors, while the mid-dorsal blade rises to assume the position for [j]. If the blade rises by

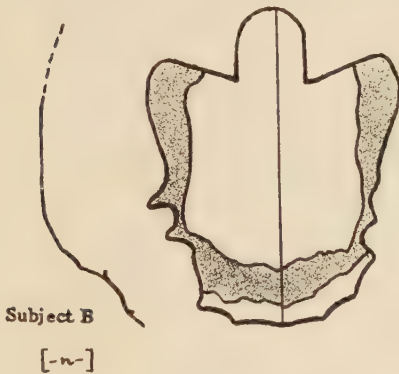


Fig. 97

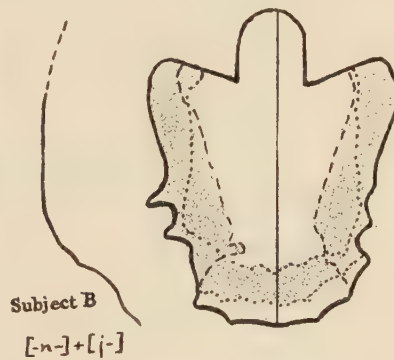


Fig. 98

anticipation at the same time as the tip (a process which is suggested quite clearly in the radiograph in Fig. 99), and if it actually comes in contact with the palate, the position is that for [ɲ:] as in Fig. 104. But if there is a midpalatal contact, the denti-gingival contact becomes unnecessary, so to speak, and there remains nothing of the contact for [n].

In passing from a vowel position to the position for [ɲ] the tongue assumes momentarily, *en passant*, the position for [j]. This passing-sound, or on-glide, was at one time sufficiently audible to be recorded in the spelling *-ign-*, as well as *-gn-*, to represent this sound. It had the further effect of lifting a preceding vowel.

When, through the loss of posttonic vowels, the sound [ɲ] had become final, the explosion or *détente* became weaker and disappeared, while

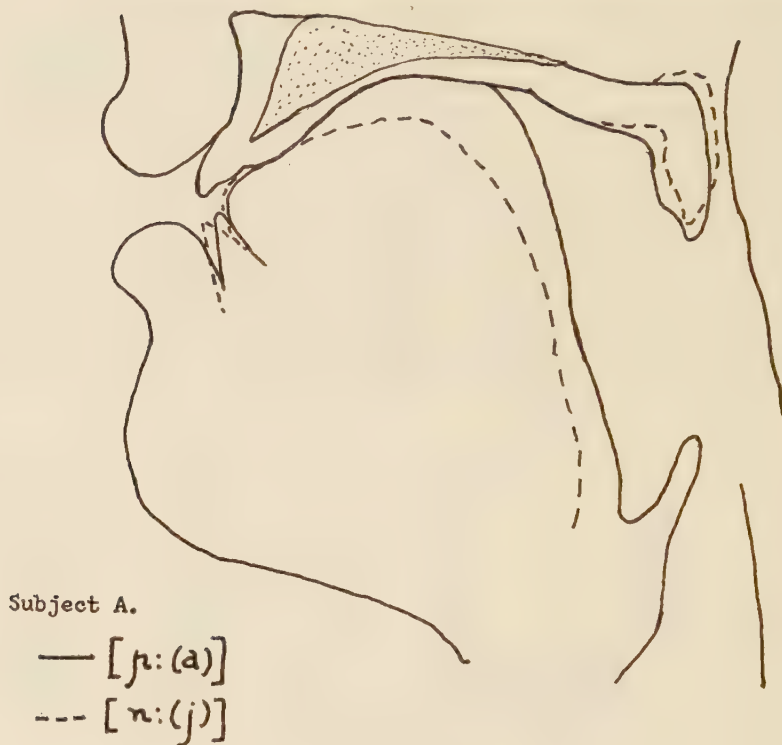


Fig. 99

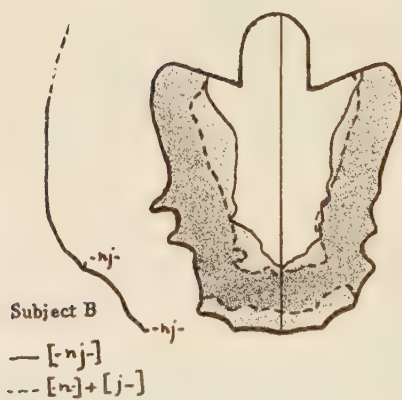


Fig. 100

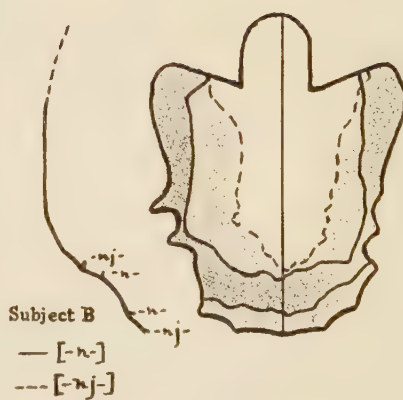


Fig. 101

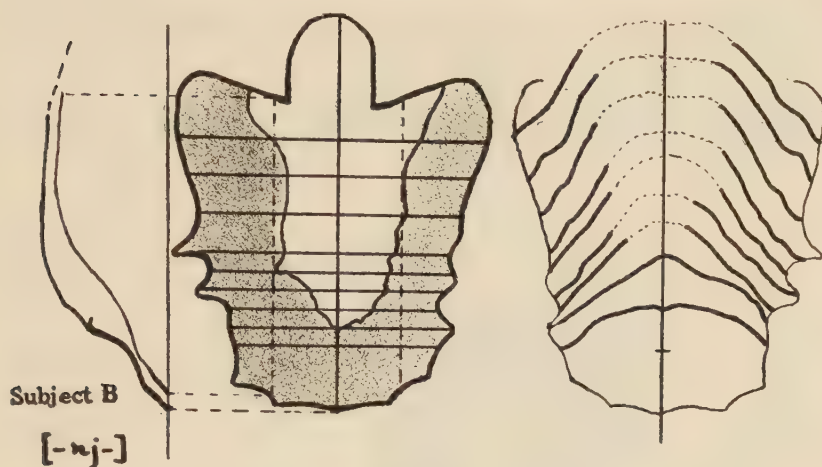


Fig. 102

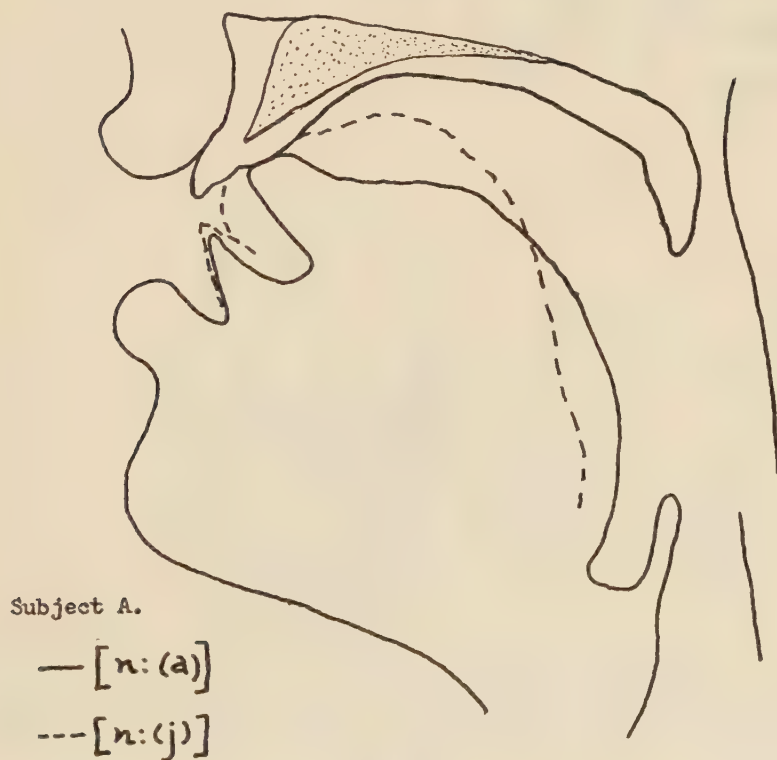


Fig. 103

the nasality of the consonant was anticipated in the pronunciation of the vowel.

balneu [banjo] > [baŋ] > [bãjŋ] > [bẽ]

montanea [montanja] > [mõntãŋə (mõntãjŋə, mõntẽŋə)] > [mõtəŋ(ə)]

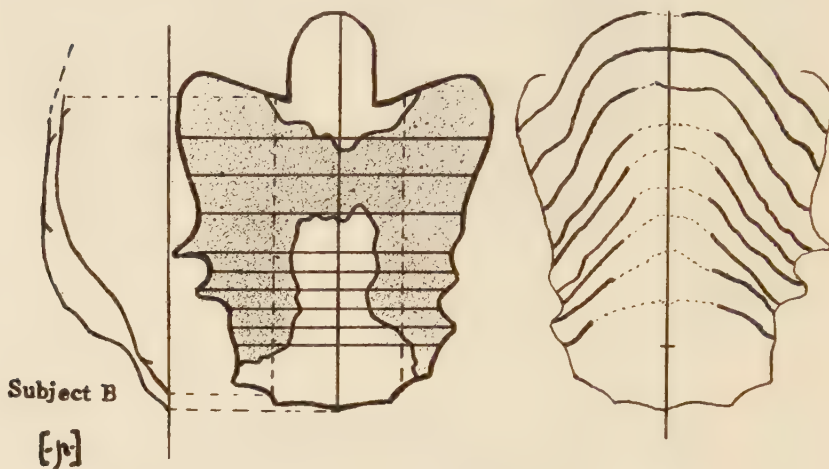


Fig. 104

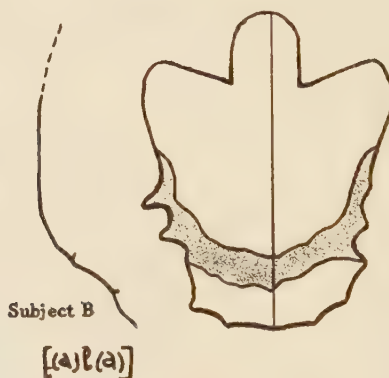


Fig. 105

[l̥] INFLUENCED BY [j]

The consonantal combination [lj] developing from Latin into French parallels to some extent that of [nj]. In Figs. 105, 106 appears what may be considered a 'normal' [l̥] as pronounced in the word *alla* by

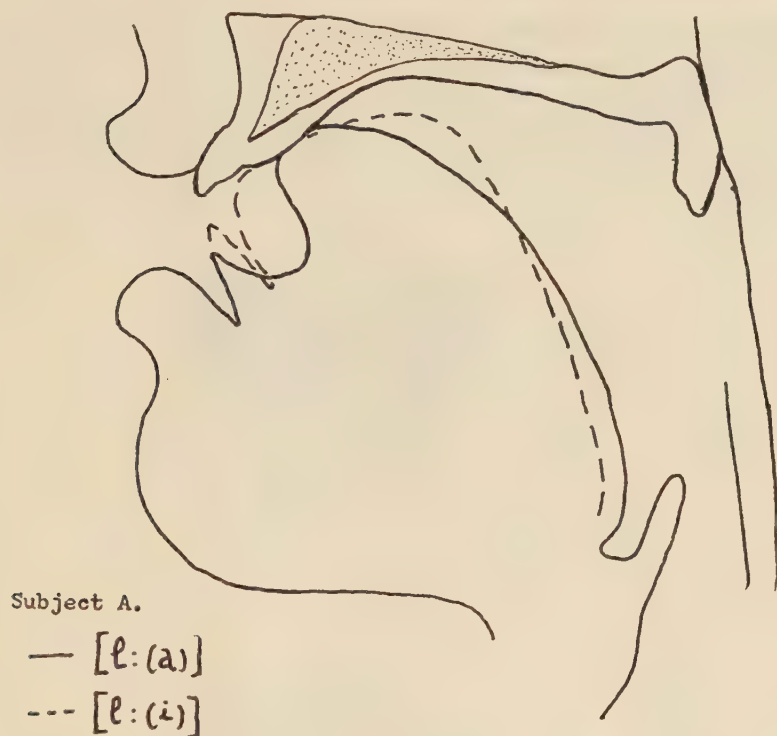


Fig. 106

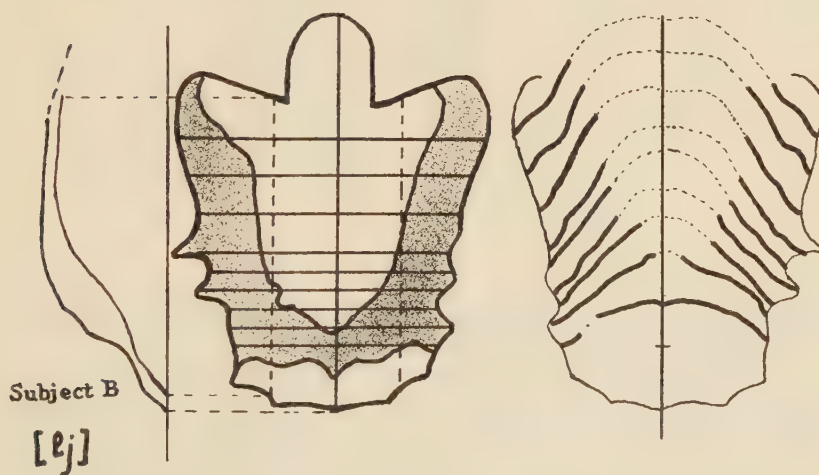


Fig. 107

subjects B and A respectively. The radiograph tracing shows also the modification introduced into the contact of the tongue against the palate and the curve of the median line, when [l] is followed by [i]. Again the spread is doubtless exaggerated in the radiograph, as may be seen by comparing it with the palatogram for [lj] in Fig. 107. Subject B did

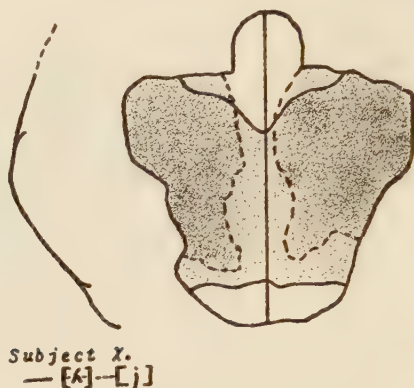


Fig. 108

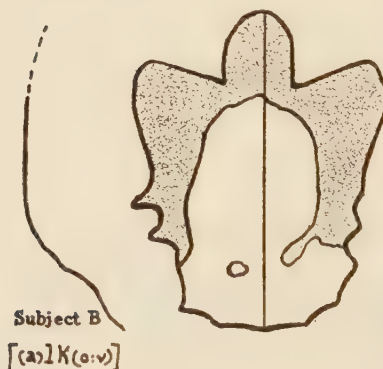


Fig. 109

not naturally possess the sound [ʌ]. A palatogram of that sound compared with [j] is presented in Fig. 108.

The combination [lj] having shifted to [ʌ], persisted in intervocalic and final position until practically contemporary times, when it simplified and opened to [j].² But in arresting position, followed by another

² E. Bourciez, *Précis historique de phonétique française* 246-7 (Paris: Klincksieck, 1926): La réduction de *l* à *y* (provenant de ce que la langue au lieu d'adhérer

consonant, [ʎ] was probably velarized to [ɫ] and vocalized along with other [ɪ] (<1) to give [u] (cf. Fig. 110). After [i], however, [ʎ] followed by another consonant was lost, probably by relaxing the median closure, producing the stage [j] which was absorbed by the vowel [i].

The evidence here presented does not show a very strong tendency to pronounced [nj] as [ɲ] and [lj] as [ʎ]. There is little doubt, however, that such pronunciations occur quite commonly in French today.

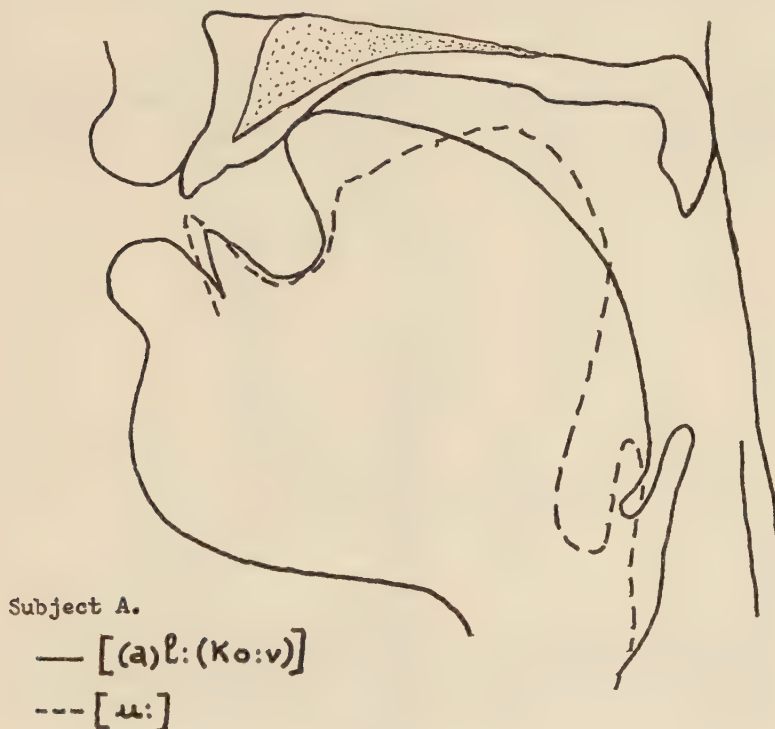


Fig. 110

Union [ynɔ̃] rather than [ynjɔ̃], *allié* [aʎe] and not [alje].³ This fusion of the two consonants into one articulation is doubtless unconscious.

au milieu du palais s'en est peu à peu détachée) est au contraire d'origine toute moderne. On la rencontre d'abord, vers le milieu du XVII^e siècle, dans les Mazarinades de 1648, où une prononciation *cayou*, *fiye* (pour *caillou*, *filie*) semble venue des patois de l'Ile-de-France.

³ Kr. Nyrop, op. cit. 1.323-34, 339.

Subject B, as has been stated, believed that he did not know how to produce [ʎ].

It is to be noted that here as in the case of [ʎ] < [kl] (see p. 74), [ʎ] seems to arrest the development [a] > [ɛ, e]:

palea [palja] > [paʎɐ] > [paʎ:ə] > [pa:j, pa:j]

doliu [dɔljo] > [dwɔljo] > [dweʎ:] > [dœʎ] > [dœ:j]

**tripalios* [trebaljos] > [treβaʎs] > [travaʎs] > [travaus] > [travo]

filios [filjos] > [fiʎs] > [fiʎts] > [fijts] > [fi] > [fis]

[s] AND [z] INFLUENCED BY [j]

The Modern French articulations of the combinations [sj] and [zj], Latin *-ssi* + vowel and *-si* + vowel respectively, show no tendency to

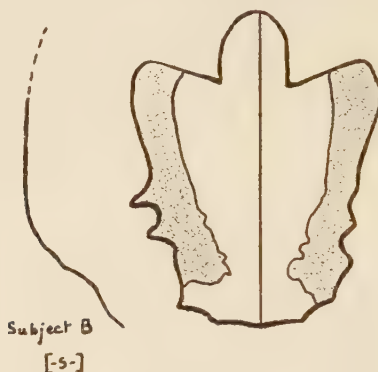


Fig. 111

pull back the articulation zone (the narrowest point of constriction) of [s] and [z]. The developments of *mansionem* > *maison* and **bassiare* > *baissier* seem to be cases of anticipation. Possibly the stages were

mansione [masjone] > [masjon] > [majsjön] > [majzön] > [mezõ, mezõ]

**bassiare* [bas:jare] > [bas:jar] > [bajsjer] > [besje] > [bese]

LABIAL CONSONANTS

[p] AND [b] INFLUENCED BY [j].—For the bilabial consonants followed by [j] there is no graphic direct evidence. It may be assumed, however, that, just as in the case of [j] after the lingual consonants, the [j] was here articulated with somewhat greater tension than normally (cf. [tj], pp. 75, 79). Eventually this gave rise to a palatal occlusion,

which was substituted for the bilabial occlusion. Thus: [-pj-] > [t], [-bj-] > [d] and [mj] > [ɟ] = [d] nasalized.

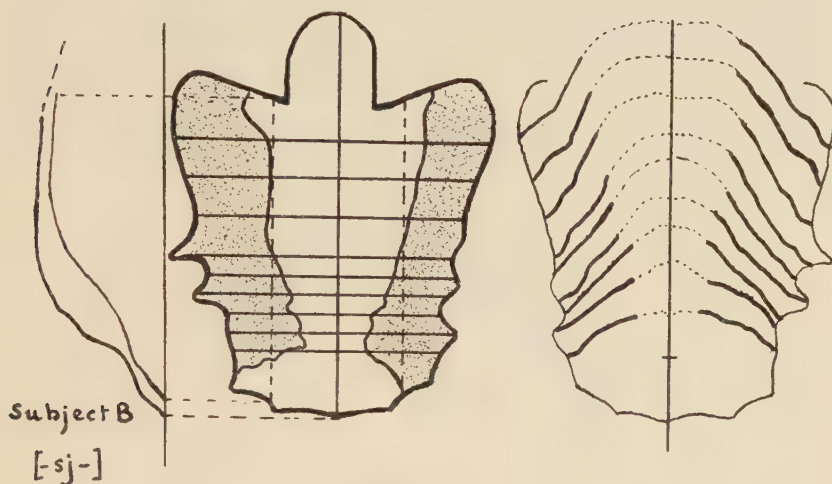


Fig. 112

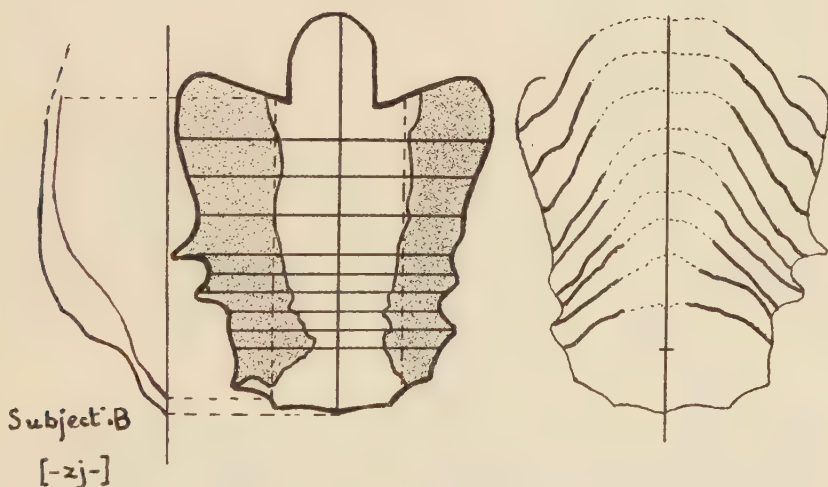


Fig. 113

The mechanics of this process are perhaps as follows: when the bilabial occlusion is made the lower jaw is brought up quite near to the upper, and raises the whole of the tongue with it. The tongue position meanwhile is preparing for [j], by anticipation. (Fig. 115 reproduces

the radiograph of [b:(i)] compared with that of [i:], and shows this anticipation.) By the movement of the lower jaw the tongue is brought into contact with the palate during the occlusion produced by the lips. This anticipated [j] closure is undoubtedly voiceless when in combination with [p] : [pɕ], the tension of [ɕ] overlapping with the tenue of [p]. Combined with [b], the anticipated [j] remains voiced, but overlaps with the occlusive. The bilabial nasal would exert a similar influence: [j] remaining voiced would become nasalized, since the velum is still

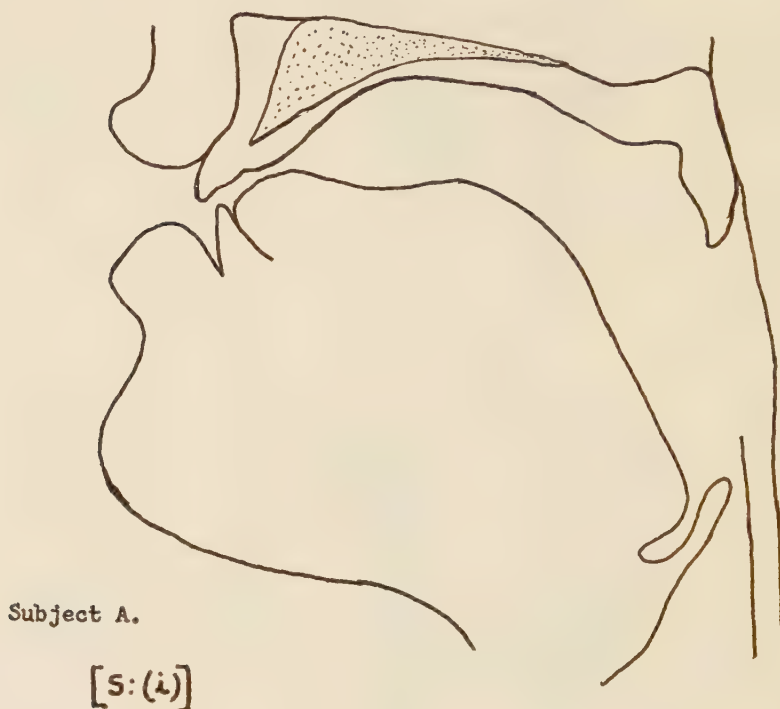


Fig. 114

down during [m], hence during that part of [j] which overlaps with it. In this manner the modifications introduced would have been: [pj] > [pɕ] > [pt̚]; [bj] > [bɕ] > [bt̚]; [mj] > [mɕ] > [mt̚]. In each of the last transcriptions the intention is to show the phenomenon of overlapping. In [pt̚], [bɕ], [mɕ] the releasing of the bilabial occlusion is immediately followed by the tenue and détente of the palatal articulation. Of the two articulations in these groups the bilabial occlusion has become now an arresting (weak) consonant. Since its détente has assumed the nature of a

palatal sound, its bilabial quality is obscured, the occlusive element is then liable to be shifted and attracted to the prepalatal region: [t:], [d:], [d̃:]. There is most probably a prolonged articulation of these occlusive-constrictives to take up the time of the bilabial occlusion plus the prepalatal constriction. This long articulation results in effectually checking the preceding vowel.

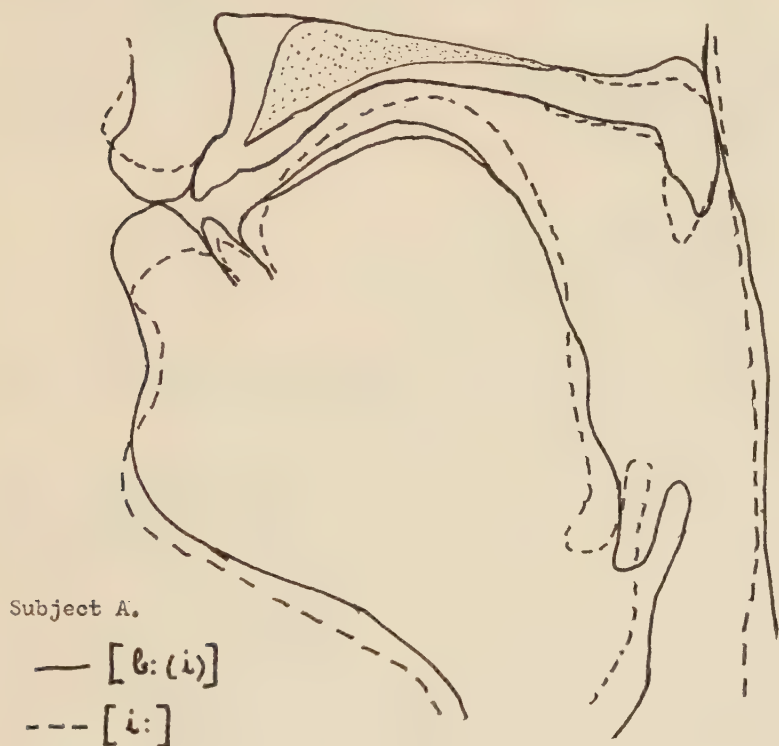


Fig. 115

The voiceless [t:] because of its duration remains voiceless, as do originally voiceless double consonants, resisting voicing. The voiced [d:] similarly resists relaxing until late. The nasal [d̃:] causes the preceding vowel to be nasalized. But in region and subsequently in manner these articulations follow the course of development which has already been noted: [t:] > [c:] > [f(:)]; [d:] > [ʃ:] > [ʒ(:)]; [d̃:] > [ʃ:] > [ʒ(:)].

sapiam [sapja] > [saptə] > [saʔ:ə] > [sac:ə] > [saf(ə)]

**rabiam* (*rabiem*) [rabja] > [rabdə] > [rad:ə] > [raʃ:ə] > [raʒ(ə)]

simium [simjo] > [simd̃ə] > [siḡ:ə] > [sīʃ:ə] > [sēʒ(ə)] > [sẽ:ʒ(ə)]

CHAPTER V. THE LOSS OF CONSONANTS

OCCLOSIVES

BETWEEN VOWELS.—1. [k, g]. The back occlusives, voiceless as well as voiced, were lost in the development of French from Latin, in the following circumstances:

a. When followed by a back vowel [u, o, ə], and preceded by any vowel:

securum [sekuro] > *sûr* [sy:r]

augustum [agosto] > *août* [u]

b. When followed by [a] and preceded by a back vowel [u, o, ə]:

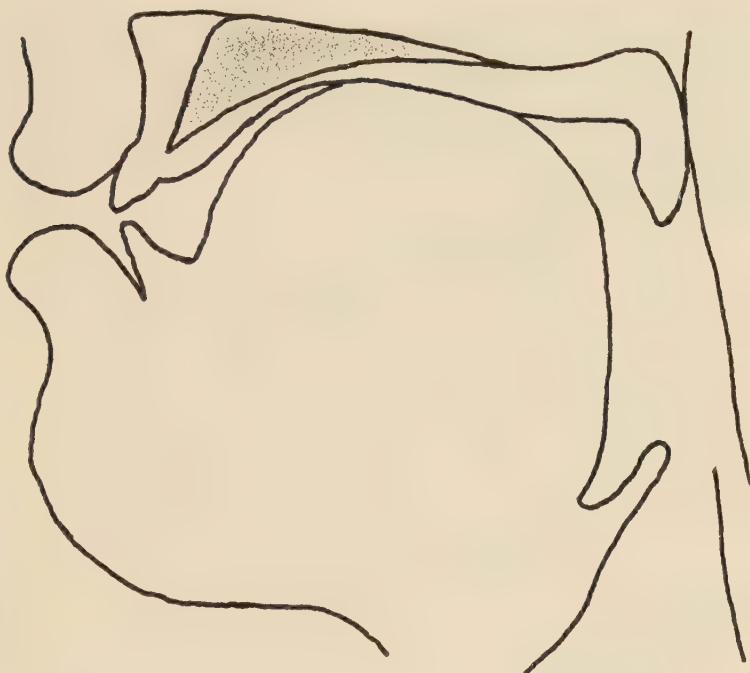
iocare [jəkare] > *jouer* [ʒue, ʒwe]

ruga [ryga] > *rue* [ry]

In Fig. 116 the radiograph of [k] between back [u] vowels is presented, and in Fig. 118 [g] in the same circumstances. In the latter graph the outline of the tongue for [k] is added for comparison.

By comparing the area of contact in these radiographs with that shown in the palatograms of the same intervocalic occlusives (Figs. 117 and 119), it will be noted first, that the radiographs show much more contact, and second, that the abnormal spreading of the tongue against the palate is in front of the normal area of contact as ascertained from the palatograms. A further point that appears is that whereas Subject B consistently shows a contact farther front for the relatively lax voiced consonant, the radiographs show that for [-k-] the tongue spreads farther forward against the palate than for [-g-]. It is probable that the reason for this lies in the abnormal tension introduced by the prolonging of the closure. The velum does not offer sufficient resistance to a strong, continued push of the tongue. Since he was unable to hold a truly velar closure for the necessary length of time, Subject A probably adjusted the region of articulation against the palate in front of the normal region. The considerable bulge of the tongue behind the closure would argue also for a strong pressure. For [-g-] which is less tense the spreading forward would not take place. As has been seen elsewhere in this study, the area of contact as shown by palatograms is more trustworthy than that shown by radiographs.

Since the posterior limit of the ¹area of contact for [(o)k(u)] does not



[k:(u)]

Fig. 116

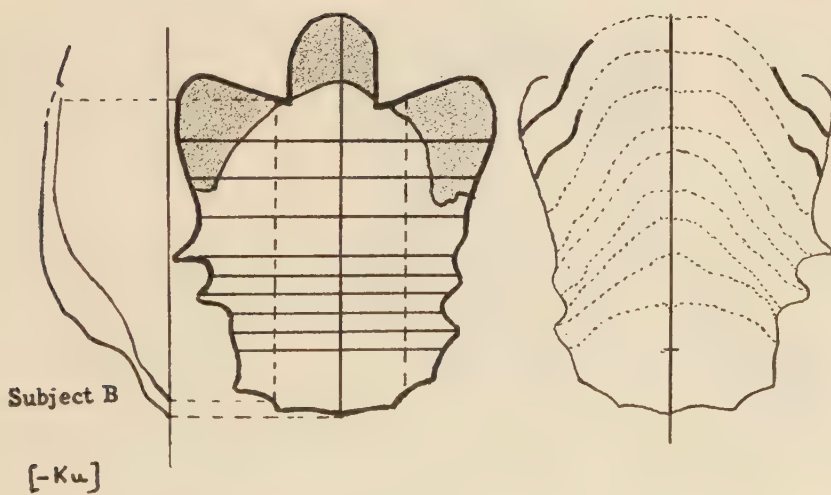


Fig. 117

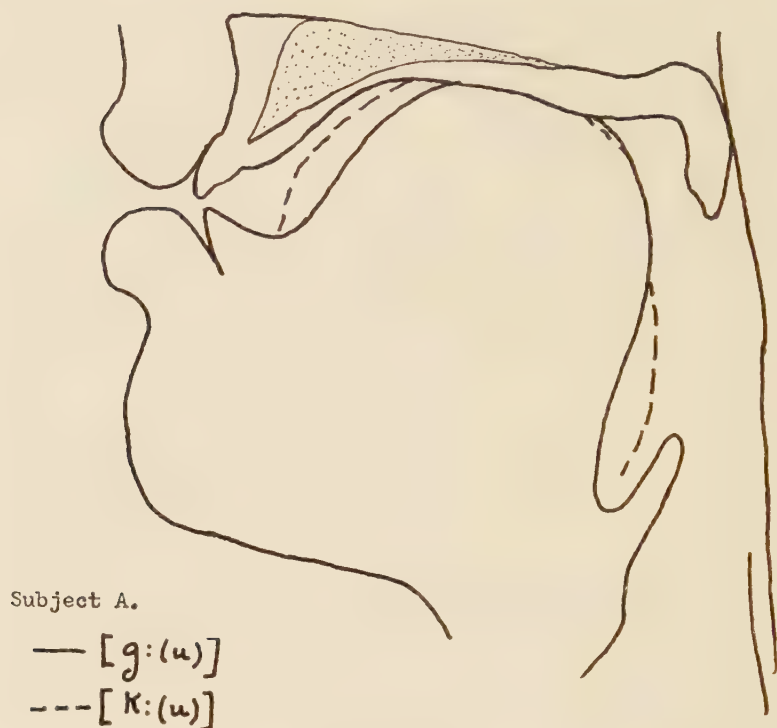


Fig. 118

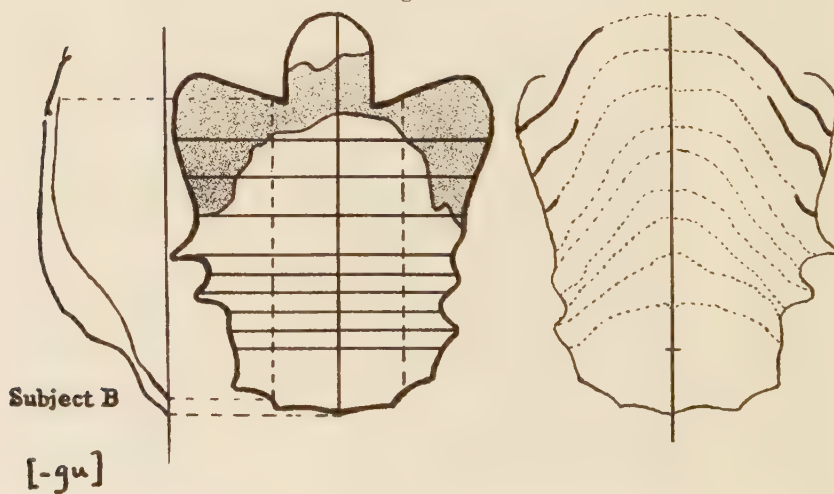


Fig. 119

show in the palatogram (see Fig. 117), there is no advantage in comparing this palatogram with that for [-g + u] in Fig. 119. However, on the analogy of other evidence (cf. Fig. 47) it is safe to assume that the area of contact for [-g + u] is somewhat smaller across the median of the palate than the area for [-k-].

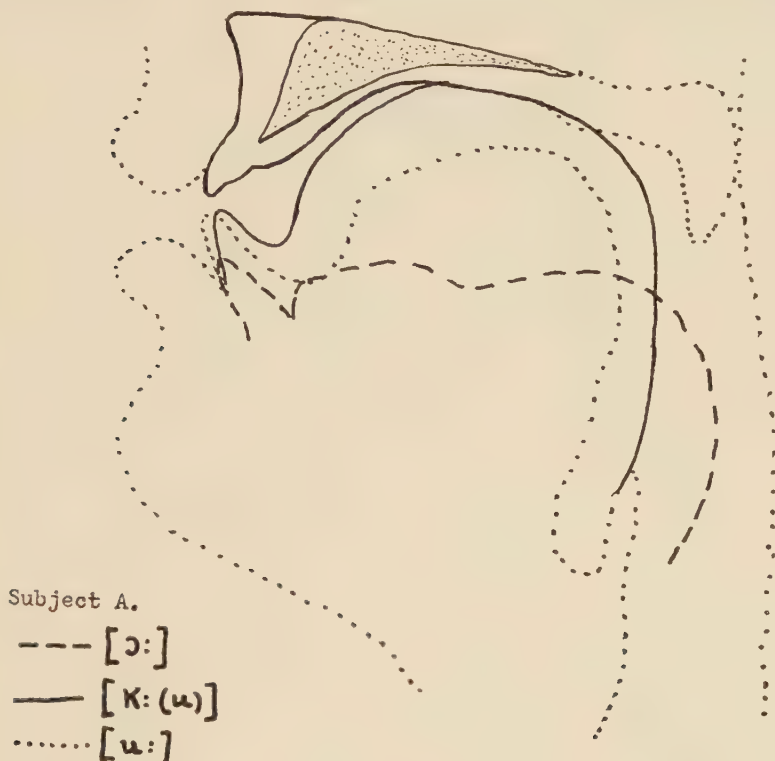


Fig. 120

The polygraph in Fig. 120 suggests the series of motions required of the tongue in pronouncing such words as *focum* [fɔkʊ]. It is perhaps because no fronting, and therefore no adjustment of the consonant to the neighboring vowels other than relaxing it, could take place that this word seems to have lost at a very early date the intervocalic consonant, thus giving the somewhat irregular OFr. form *fou*. Portuguese also shows an irregular *fogo* with close *o* quality.

A somewhat different situation is suggested by the polygraphs in

Figs. 121 and 122. The outline for [k:] in Fig. 121 is not the same as for Fig. 120 because the latter is before [u] in the word *soucoupe*, the former [k:] before [a] (cf. Appendix A). The arrows in the graphs are intended to show the path of the body of the tongue, assuming that it moves in a straight line both in tension and détente. This may be an oversimplification of the tongue movement.

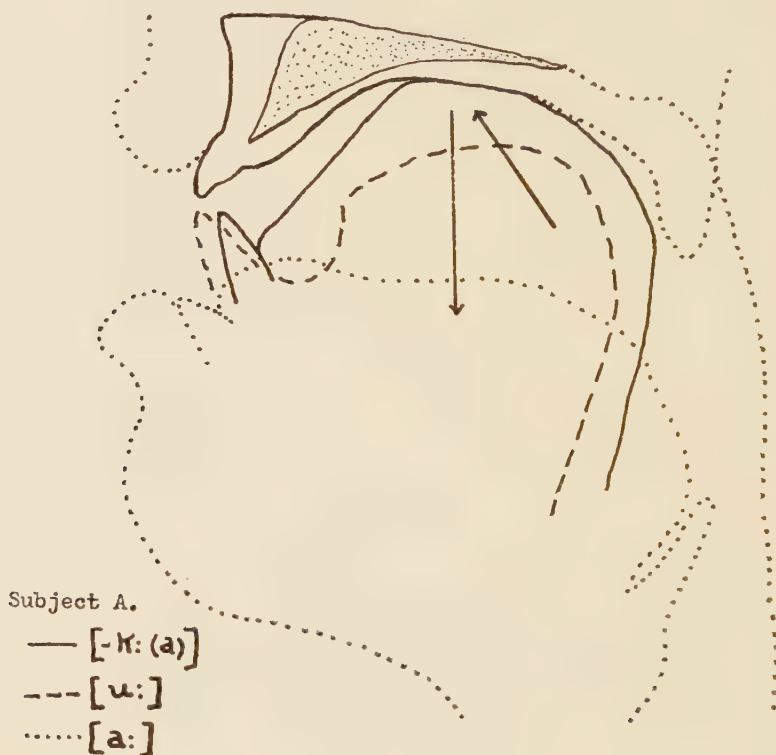


Fig. 121

However, from the evidence at hand it seems correct to say that for the closures of [k] and hence of [g], (cf. Fig. 122), the tongue moves upward and slightly forward to the closure, after which it moves down perhaps practically vertically. Note the relative flatness of the tongue for the position of [a] and that in this position the tongue bulges toward the pharyngeal wall, tilting the epiglottis back (cf. the position of the epiglottis for [u], Fig. 120, and for [a], Fig. 121). It seems, therefore,

safe to say that there is no actual tendency toward fronting in the direction of the tongue movements.

Two tendencies are operative then in opening the occlusion of [k] in Latin words like *securum* and *iocare*: first, the laryngeal inertia which spreads voice vibration through the voiceless occlusive, thus producing [g], which is less tense by nature; second, the tendency to anticipate

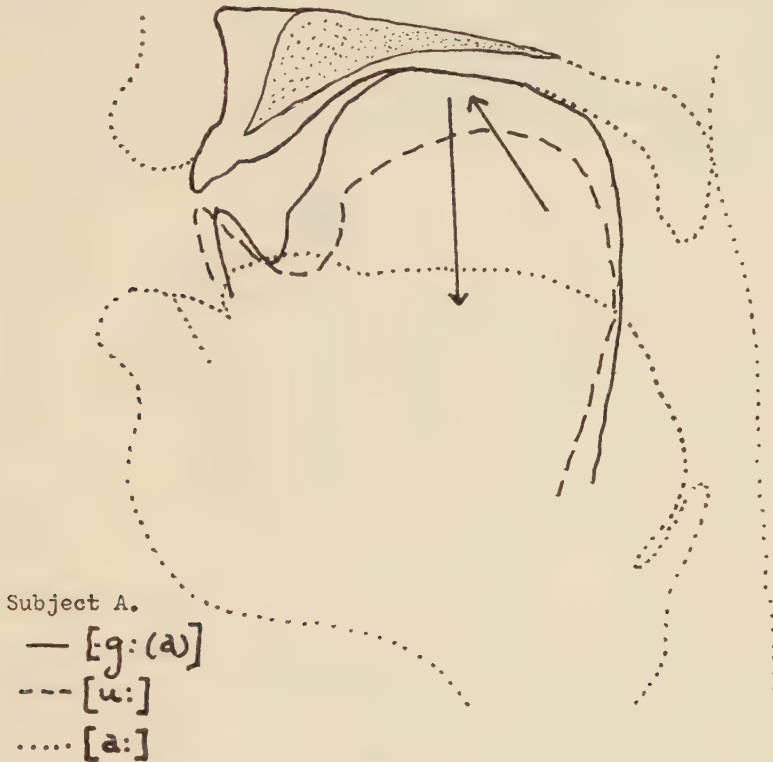


Fig. 122

especially the position immediately following. In these two words, as has been seen, the tongue is preparing to move down and back, and principally down. The closure for [g] in Latin *augustum* and *ruga*, and also in the pronunciations, somewhat later,¹ [seguro] and [ʝogar] (cf. Mod. Portuguese [seguru, ʒugaɾ]), is further relaxed because of

¹ M. K. Pope, *From Latin to Modern French* 135 (Manchester University Press, 1934): '... before the end of the sixth century'.

lingual inertia. The next stage is then a voiced fricative constrictive [g] (Fig. 123). The presence of a back vowel either on both sides of this consonant or before it, made it easy to substitute a bilabial constriction for the velar constriction, thus giving [w]. This served as a kind of transition sound ('glide') between the two vowels involved, and was then absorbed into the back vowel or dropped.

securum [sekuro] > [seguro] > [segu] > [sewur] > [səyr] > [sy:r]

augustum [agosto] > [agost] > [awost] > [aust] > [aut] > [əu] > [u]

iocare [jəkare] > [ɟogar] > [jogar] > [jower] > [ʒu(w)e(r), ʒwe]

ruga [ruga] > [rugə] > [ruwə] > [ry(ə)] > [ry]

2. [t, d] INTERVOCALIC. The dental occlusives, voiceless [t] and voiced [d] intervocalic (Figs. 124 to 128), show the same comparative



Subject X.
[(a)g(a)]

Fig. 123

laxness of the voiced consonant. The evidence available does no more than point to a further relaxation (Fig. 124) and eventual disappearance (cf. Span. *amado*, pronounced [a'mao] as often if not oftener than [a'maðo]).

amatam [amata] > [amadə] > [amæðə] > [amɛə] > [ameə, ɛmeə] > [eme]

fidem [fede] > [fejð] > [fejθ] > [fei] > [foi] > [fwɛ] > [fwa]

3. [p, b] in contact with labialized vowels [u, o, ə]. Little evidence is available to show the development of bilabial occlusives [p] and [b]. In the radiographs traced in Figs. 129 and 130, it is again apparent how lax the voiced occlusion is as compared with the voiceless. Historically, this voiceless [p] was voiced and then relaxed further to a labiodental

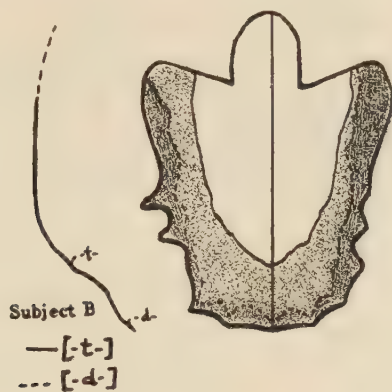


Fig. 124

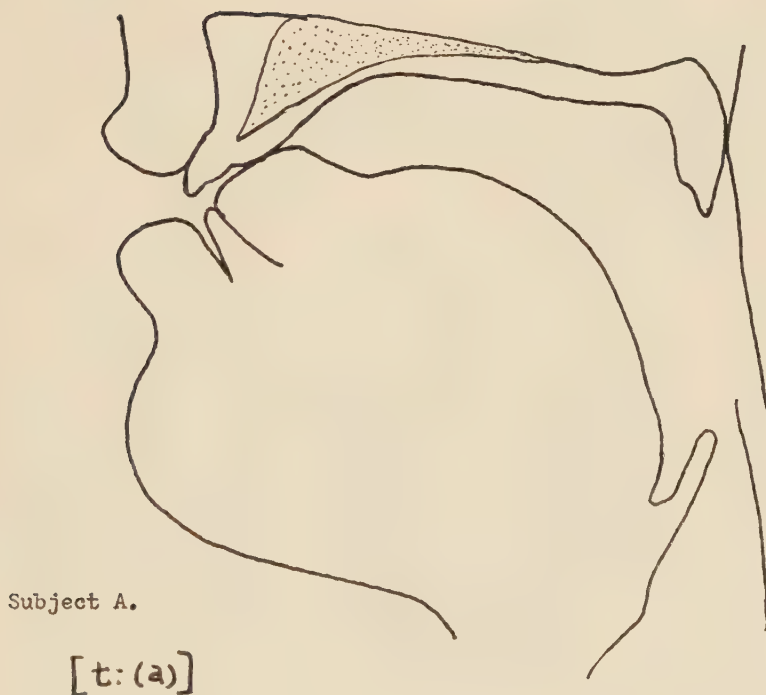


Fig. 125

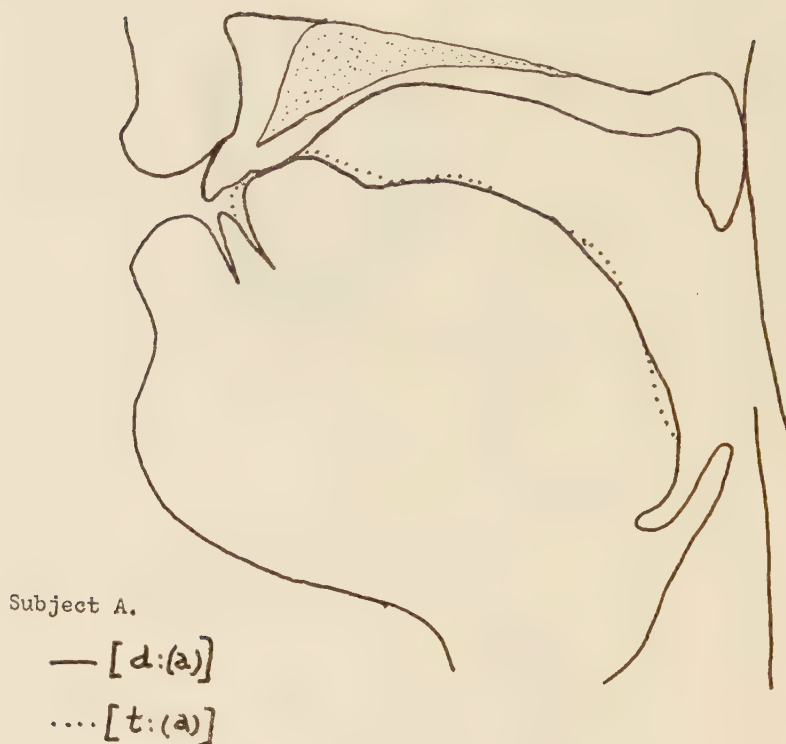


Fig. 126

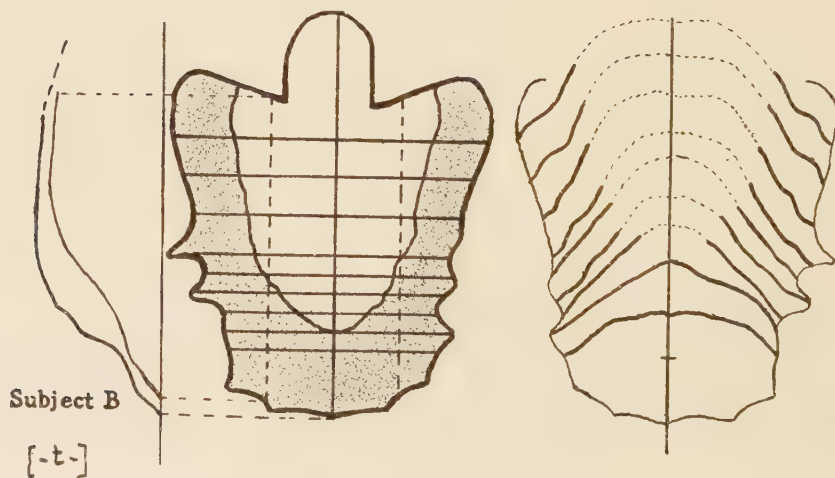


Fig. 127

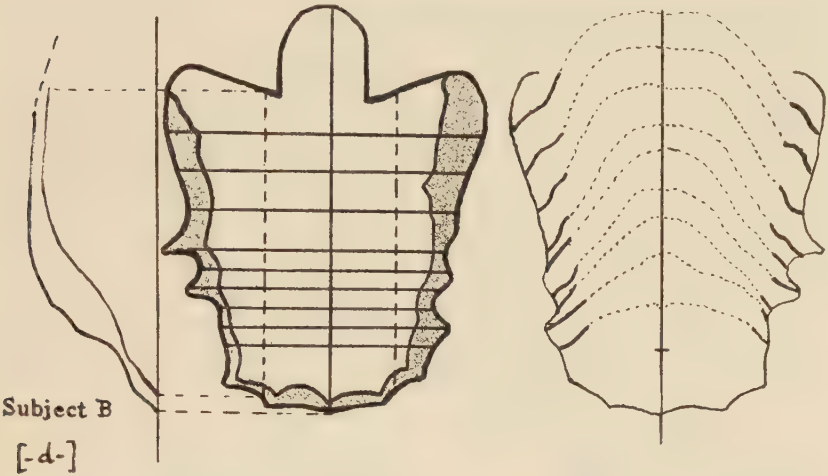


Fig. 128

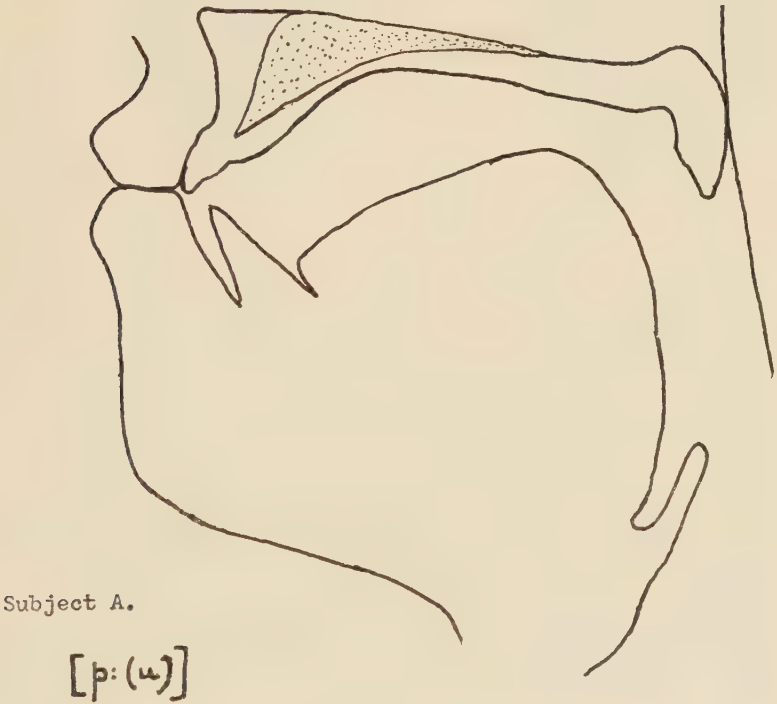


Fig. 129

constrictive [v], probably passing through the stage of [β], bilabial constrictive.

ripam [ripa] > [ribə] > [riβə] > [rivə] > [ri:v]

But [β], passing to relaxed [v] early, was articulated in the same way as [β] < [w], the Latin consonantal *u*.

This [β] from both sources became labiodental [v] when not influenced by a contiguous back vowel. [β] when in contact with a labialized

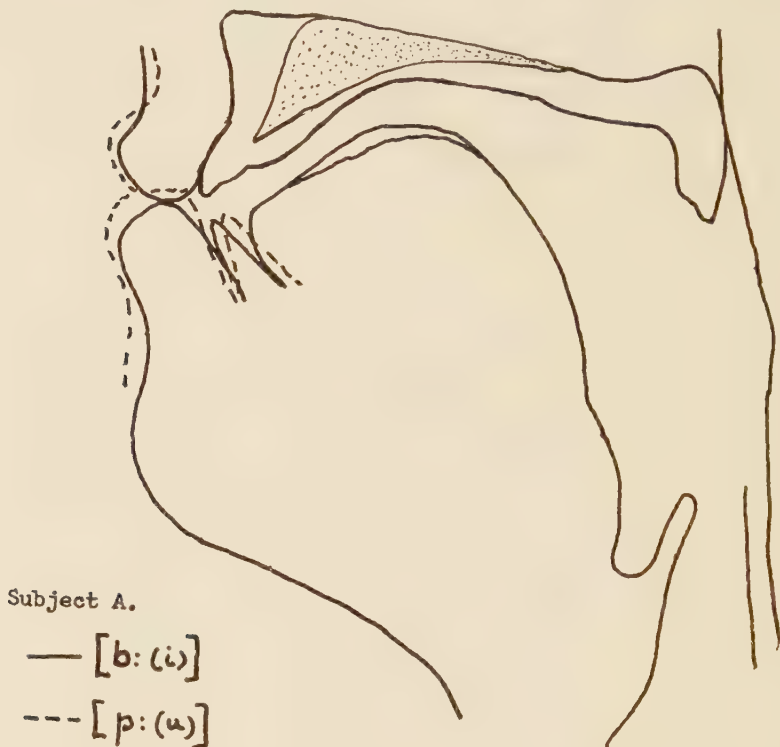


Fig. 130

vowel [u, o, ə], relaxed further to [w] and was absorbed or lost, as Latin consonantal *u* had been lost earlier.²

faba [faba] > [faβə] > [fævə] > [fɛvə] > [fɛ:v]

viva [wiwa] > [βiβə] > [vivə] > [vi:v]

**nubam* (*nubem*) [nubə] > [nuβə] > [nuwə] > [nyə] > [ny]

² Cf. Appendix Probi 4.197-9 Keil: *avus nōn aus, . . . rivus non rius, pavor non paor.*

IN FINAL POSITION.—Latin final occlusives *t*, *d*, *k*, which come down into Old French, were relaxed to voiceless $[\theta]$ for the two dentals, and $[x]$ for the velar. The latter was lost early at the end of an unstressed word: *ecce hoc* > *ço* $[tso(x)]$; *aut* > *od* $[o(\theta)]$; *ad* > *ad* $[a(\theta)]$. The final fricative constrictive $[\theta]$ was lost entirely 'at latest by the middle of the twelfth century.'³

These final consonants are in weak position (cf. p. 19), the energy of the syllable-pulse being nearly spent. The tongue, instead of assuming, holding, and releasing the position for the consonant, merely approaches the position. It makes a sketchy tension. The tenue is very slight, if there is any at all, and the détente is omitted entirely. The détente disappears because the consonant is final. The consonants in these

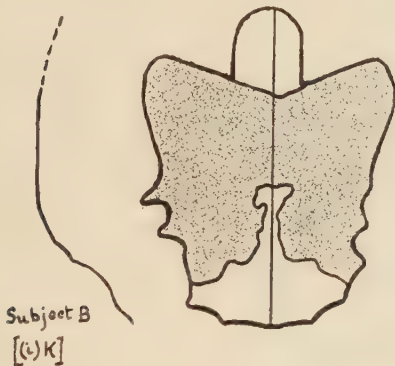


Fig. 131

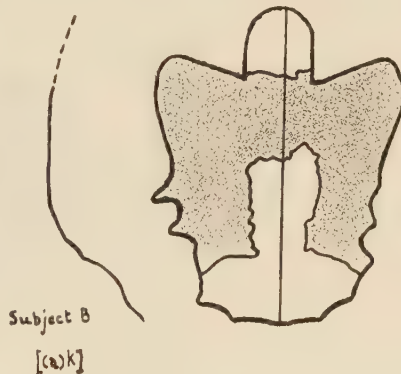


Fig. 132

circumstances are implosive: only the first of the three parts of an articulation is fully performed.

The voicelessness of these finals does not, as elsewhere, mean tenseness, but rather that the vocal cords as well as the tongue are progressively ceasing their activity. Cf. Span. *comer* $[ko'meɹ]$.

It is therefore evident that the weaker the syllable-pulse, the more readily the final (arresting) consonant tends to drop.

This is particularly the case with final $[k]$ which requires, for a complete articulation, that the tongue as a whole move up to the velar or postpalatal region. In unstressed words $[k]$, passing through the stage $[x]$, was lost. In stressed words, however, it was kept through the OFr. period when it followed a back vowel, but was fronted eventually

³ Pope, *op. cit.* 140.

to [j] when it followed [a] or a front vowel. Figs. 131 and 132 show the modern French articulation of [k] in *bac* and *pique*. The fronting tendency is clearly apparent.

ab hoc [abək] > [aβwək] > [avwək], OFr. *avuec*

fac [fak] > [faḱ] > [faj], OFr. *fai*

Possibly also *sic* [sik] > [siḱ] > [sij] > [si]

Similarly, no doubt, *lacum* [lako] > [lak] > [laḱ] > [laj], OFr. *lai* (the modern form *lac* is a later borrowing).

In most cases, however, [k] originally intervocalic had been lost (pp. 95-8) earlier than the loss of post-tonic vowels. But [k] and [g] in releasing position after another consonant persisted until much later.

porcum [pərko] > [pərḱ]

borgu [borgo] > [borg] > [bork]

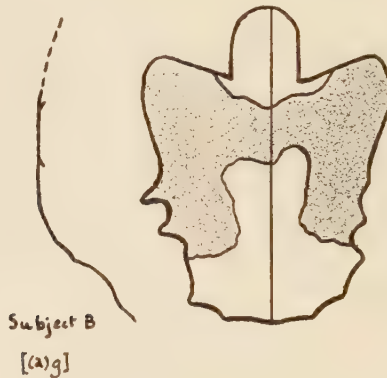


Fig. 133

The fricative voiceless constrictive resulting from [t] and [d], become final, was lost, like [θ] from original final [t] and [d], in the course of the eleventh and twelfth centuries.

finitum [finito] > [finiθ] > [fini]

fidem [fede] > [fejθ] > [fej], OFr. *fei*

In originally releasing position [t] and [d] persisted, as did [k] and [g], when they became final, and unvoiced:

portum [pərto] > [pərt]

tarde [tarde] > [tard] > [tart]

The bilabial occlusives also were kept down to Old French in originally releasing position:

corpu [kərpo] > [kərp], OFr. *corp*

plumbum [plombo] > [plomp], OFr. *plomb*

All these Old French occlusives remained for a considerable time. They were first lost when followed by another consonant, but still pronounced when preceding a vowel. This situation is described by grammarians and theoreticians of the sixteenth century. This is essentially the basis of modern liaison.

In other words, if the final [p], [t], [k] was releasing of a syllable by becoming initial of syllable in combination with the initial vowel of the next word in the phrase, it was kept, and still is generally. But if followed by a consonant, whether *s* of flexion, *s* of plurals or a consonant initial of the next word, it was then in weak position (between two other

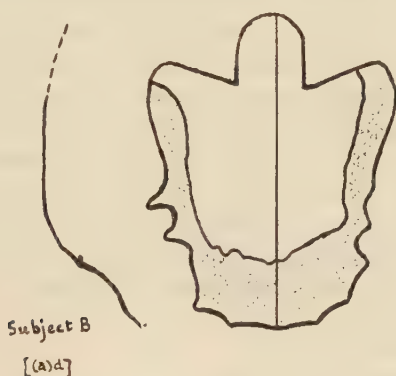


Fig. 134

consonants) and was lost. Before a pause it probably became implosive and thus lost acoustic value, and then was dropped entirely.

Cf. *trop aimable* [trɔpɛmabl]

trop vif [trɔvif]

c'en est trop [sɑ̃ɛtro]

fort heureux [fɔrtøʁø]

fort juste [fɔʁʒyst]

il est très fort [ilɛtʁɛfɔːʁ]

un long ennui [œlɔ̃kɑ̃ni]

un long mois [œlɔ̃mwa]

tout au long [tutolɔ̃]

The articulation of phonetically final consonants in Modern French does not show any tendency toward relaxation. Figures 105 and 106 show contact of the tongue against a considerable area of the palate. There may be some tendency to make absolute finals, and finals before consonants, implosive. This is much slighter than in English and for

pedagogic reasons great emphasis has been laid on final consonants in French being releasing, having a definite, if not necessarily audible, détente. No evidence of implosive occlusive articulation was available in this study.

In the articulation of [-d] (Fig. 134), the tongue made the closure in the back on the left against the grinding surface of the molars. The artificial palate did not extend so far outward.

CONSTRUCTIVES

IN WEAK POSITION, FINAL OF WORD OR OF SYLLABLE.—For the investigation of final constrictive consonants, Subject B was asked to make several records on the kymograph using the mouthpiece alone. No other means of investigation was used because in the time available it was feared that Subject B could not become sufficiently accustomed to spiograph, nasal olive, tongue-bulbs to retain normal articulation when these were used. Obviously the pronunciation must be as natural as possible. A large mouthpiece was used. It had a vent to avoid the damming up of air in the short tube leading to the tambour. This was of small size and covered with very thin rubber.

The material used in this experiment comprised fifteen sentences:

1. Il s'est cassé la patte.
2. Sa femme prépare la pâte.
3. Non, c'est une très grande faute.
4. Voyons donc si ça pousse.
5. C'est un homme de haute taille.
6. Il donne de bons conseils.
7. C'est une jolie petite fille.
8. Descendez à la cave.
9. On a trouvé le cadavre.
10. L'ours s'échappa de sa cage.
11. Voyez comme il patauge.
12. On a détruit sa case.
13. On ne le trouve nulle part.
14. Défends-toi sans fléchir.
15. Il en fait le parcours.

It had been previously established by direct auditory observation that Subject B read these sentences making certain elisions which brought the group stress upon the sixth syllable in each sentence. The six syllable sentences were individually short enough to be pro-

nounced as single breath groups.⁴ They were comparable as to rhythm. The intensity of the stress itself, therefore, might be expected to be fairly constant from one sentence to another. The vowel of each stressed syllable would be comparably lengthened, in so far as stress is a factor in lengthening. And the effect upon the consonants would presumably be comparable. The intention at least was to control variables as much as possible in order to compare truly comparable phenomena.

Sentences 1, 2, 3, 4 were used as controls. The syllables *patte* (no. 1) and *pousse* (no. 4) have short vowels, not lengthened by the stress, and final consonant, consequently unaffected in length whether occlusive or constrictive. The stressed syllables *pâte* and *faute* (nos. 2 and 3) are another kind of control: a vowel, long 'by nature', not lengthened simply because of the stress. All the other examples represent cases of lengthening due to stress.

This selection was based on the theory that if there were any tendency in Modern French to slight the articulation of final consonants it would be after a long vowel. This theory was built upon the well-known facts pertaining to compensatory lengthening, in both 16th and 17th century pronunciation as recommended by grammarians,⁵ and in the language soutenu of today. If when the consonant is effaced the vowel preceding is lengthened, then when a vowel is lengthened, the consonant following it may tend to be effaced.

The accompanying table (p. 108) shows the results of this experiment. The figures represent in millimeters the linear distances in the tracings. Fifteen and seven tenths millimeters equals one tenth of a second. Since only relative lengths were to be considered, it seemed useless to translate these measurements into terms of time.

The fifteen sentences were recorded twice, along with other material which does not enter into this study. The speed with which the sentences were to be read was left entirely to the subject. The greatest variation in time consumed in reading the whole sentence was introduced in No. 13. The second reading was approximately .3 second longer than the first. In several cases the time value of sentences was exactly repeated or came within a fraction of .1 second. It is therefore concluded that the two readings were sufficiently similar as to time, hence length of sounds, to justify averaging together the lengths of vowels and the lengths of final consonants.

⁴ In the reading of sentence No. 6, Subject B placed a secondary stress upon the syllable *donne*.

⁵ Pope, *op. cit.* 205-7.

TABLE OF RELATIVE LENGTHS OF STRESSED VOWELS AND FINAL CONSONANTS

	Sound	Average Length in mm.	Sound	Average Length in mm.
1. i sɛ kɑ sɛ la 'pat	a	32.75	t	31.75
2. sa fam prɛ pɑr la 'pa:t	ɑ:	40.50	t	35.50
3. nɑ sɛ tɪn trɛ grɑd 'fo:t	o:	37.50	t	23.25
4. vwa jɔ dɔk si sa 'pus	u	36.00	s	37.80
5. sɛ tæ nəm də ot:ɑ:j	ɑ:	41.60	j	24.90
6. i 'dɔn də bɔ kɔ 'sɛ:j	ɛ:	40.60	j	26.25
7. sɛ tɪn ʒɔ lip tit 'fi:j	i	27.25	j	22.10
8. de sɑ de za la 'ka:v	ɑ:	43.25	v*	22.10
9. ɔ na tru vel ka 'da:vr	ɑ:	44.60	vr	30.50
10. lʊr sɛ ʃa paɖ sa 'ka:ʒ	ɑ:	46.75	ʒ	25.95
11. vwa je kɑ mi pa 'to:ʒ	o:	41.35	ʒ	21.60
12. ɔ na de truɪ sa 'ka:z	ɑ:	50.25	z*	24.40
13. ɔ nɑ lə truɪ nɪl 'pa:r	ɑ:	44.00	r**	16.75
14. de fɑ twa sɑ fle'ʃi:r	i:	49.25	r**	12.55
15. i lɑ fel pɑr 'ku:r	u:	39.00	r**	14.50

* Once unvoiced.

** Without explosion.

All the 'final' consonants except [r] showed détente. But [r] never showed any explosion. The tracing gradually dwindles off to a straight line. This peculiarity has been noted consistently on oscillograms as well as kymograms by various workers employing French subjects in the Phonetics Laboratory of the University of Chicago.

The control sentences show approximately the same length for the short vowel as for the consonant following (Nos. 1, 4). The other two control sentences are characterized by somewhat longer vowels and fairly long consonants. The consonant [s] is the longest consonant in the whole series (No. 4).

The combinations of vowel + [r] show the greatest disproportion in length between vowel + consonant. This consonant also shows consistently an implosive type of tracing, and only this implosive consonant was relatively much shorter than normal (from one half to one third as long as normal).

From this evidence it is proposed that the disappearance of con-

strictive fricatives in weak position, whether before another consonant, which was releasing (therefore strong), or in absolute final position, followed the same course as the occlusives treated above: they became implosive, relaxed to a kind of [h] sound voiceless, then lengthened the preceding vowel by compensation.

Ofr. *feste* [festə] > [fɛhtə] > [fɛ:tə] > [fɛ:t]

The levelling of all final vowels to short vowels is doubtless a phenomenon which belongs to modern Parisian French. (The provincial dialects do not have this tendency so strongly marked.) Once the vowel was felt to be final, after the loss of the consonant, it conformed to the general pattern of the language and was shortened.

cas [kas] > [kah] > [ka:] > [ka, ka]

CHAPTER VI. CONCLUSION

Phonetic observations are necessarily static. A consonant articulation produced by a modern Frenchman represents only a moment in the history of that consonant. At no time in the history of a language may all the stages of any development be found. It is logically impossible for language to change without discarding the earlier phenomena of its progress. But we may find, at any given time, certain evidences of tendencies which seem to be consistent with tendencies which have brought about historical changes. This is particularly true when the observations are limited to physiologic phenomena. It is possible that a full determination of the basis of articulation of a linguistic group would permit of the conclusion that it is fairly constant.

This basis of articulation as it applies to consonants may be set forth by observing the relationships among consonant articulations. There is historical evidence to show that in strong position consonants are more stable, are preserved longer, or undergo less change, than in other positions. This same principle can be restated on the evidence of modern articulations: consonants in strong position are articulated with more muscular energy, which appears as tongue pressure against the palate in the case of an occlusive, for instance. The evidence here presented concerning consonants in weak position is not sufficiently conclusive to permit a corollary statement about them, whether it be consonants followed by another consonant in the body of the word or consonants in final position.

Indeed, there is here presented practically no evidence of the loss of finals in Modern French. But are so-called finals in French really final? Does not the vocalic release ('mute *e*') of finals actually constitute a posttonic vowel? If so, Modern French does not offer any parallel in this particular to the time in the history of the language when posttonic vowels had been entirely lost, thus giving rise to real final consonants.

Similarly, intervocalic occlusive consonants were lost in the course of the development of the language, under certain conditions. The evidence of Modern French, though it does not show the actual dropping of intervocalic consonants, does point in that direction: the intervocalic is articulated with markedly less tongue pressure than the initial, for

instance, which means, as has been stated, greater instability or, in a word, relaxation.

Those peculiarities of articulation which characterize French, as well as other Romance languages perhaps, in their development from Latin, in contrast to habits of articulation belonging to other languages, are still apparent in Modern French. Present French consonant articulations in general do show tendencies analogous to those recorded in the history of the same articulations under similar conditions.

Finally it would seem correct to say that this study, partial though it be, because an insufficient number of subjects was available, justifies the belief that a more comprehensive investigation of phonologic changes from the viewpoint and with the techniques of experimental phonetics might be profitably undertaken.

APPENDIX A

All the sounds recorded, whether by radiograph or by palatogram, were given to the subjects embodied in words or phrases which offered the desired combinations. For palatograms care must be taken that the word shall contain no other sound whose articulation might cause the tongue to leave on the palate traces of contact. Thus to get inter-vocalic [-g-] the word *agape* was used. The labial consonant at the end of the word does not interfere with the artificial palate. As a general rule the words given to Subject A, who served for the X-ray investigation, contained the consonant to be radiographed between two [i] vowels, or two [a] vowels, or two [u] vowels.

Of the 92 radiographs made with Subject A, not all are reproduced in this study, but a complete list of the words and groups used is given here. (It will be noted that there are a few repetitions.)

pain, pan, ont, un, paix, la, qui, chat, tu parles! (argot parisien), *ici, si, eau, pain, seul, pâte, un, dot, porte, bonne, deux, dans, pendant, long, défunt, dauphin, plafond, défend, Anna, lisible, à jamais, alla, itinéraire, 'ougnou', gaga, dix guis, Arras, barrage, poupoule, il l'y, ci-gît, chichi, didi, bibi, alcôve, pis, fat, peau, feu, peux, bébé, pas, époux, Lesage, fait, phobie, fut, but, veuf, caca, Dada, soucoupe, tout doux, joujou, nounou, irrité, initiation, attache, Zoulou, caca, je n' dis pas, défunt, il saloppe, galoppe, pan, pâte, pont, veuve, pain, défunt, Gaza, gagna, courroux, gazouille, barrage, dégoût, chouchou, autour, cassa, nation, vous soupez, Vigny, union, Toutou, vous touchez, alcôve, iniquité, vous goûtez, lisible, toujours, illisible, 'ougnou.'*

APPENDIX B

The following words or phrases were used with Subject B for palatograms:

attends, patt'tendue, pas d' tas, tiens, Mathias, matelot, rat d' cave, Tchèque, médecin, dame, fada, fade, ode de papa, (hue) dia, Madian, Madelon, à qui, acquis, Pouqui, mica, (il) vagua, bouqua, à coup (sûr), mi-cou, ah qu'oui, couenne, cul, pic, bac, bouc, (le) bac qu'a (trouvé mon frère), (le) bac qui (a été trouvé), paquet, vaqué, qu'y a(-t-il), baqueta, axe, accès, Kra (imitation d'un Italien), axiome, acclama, haquenée, gui, (M.) Basgui, figue, gare, agape, bague, goût, bagout, fougue, (une) bague Gui, (une) bague ga(rnie), adjoint, baguier, glas, anglais, grès (imitation d'un Italien), baguenau(de), Bagda(d), amassa, passion, bazar, évasion, chat, achat, gît, Jammes, mangea, hier, bouilli, paya, y a pas, bail, là, ah lalà, alla, allier, allia, pallia, alcôve, Anna, mania, panier, Anne court, baigna, à ras, poux, peau, pis, ami, a pu, happé, peu, a fait, hein?, banc, amont, à Meung.

BIBLIOGRAPHY

EXPERIMENTAL PHONETICS

A. General

- Grammont, Maurice: Notes de phonétique générale; VIII. L'Assimilation; in *Bulletin de la Société de Linguistique* 24.1-109 (1923).
- Grammont, Maurice: *Traité de phonétique*; Paris, 1933.
- Grützner, P.: *Physiologie der Stimme und Sprache*; in *Handbuch der Physiologie*, von L. Hermann, Leipzig, 1879.
- Panconcelli-Calzia, G.: *Das Hamburger Experimentalphonetische Praktikum*; Hamburg, 1922.
- Panconcelli-Calzia, G.: *Experimentelle Phonetik in ihrer Anwendung auf die Sprachwissenschaft*²; Berlin, 1926.
- Rousselot, Abbé J.: *Principes de phonétique expérimentale*, 2 vols.; nouv. éd., Paris, 1924-5.
- Scripture, E. W.: *The Elements of Experimental Phonetics*; New York, 1904.
- Stetson, R. H.: *Motor Phonetics*; in *Archives néerlandaises de l'homme et des animaux* 13.2.1-390 (1928).

B. Radiography

- Parmenter, C. E., S.N. Treviño, and C. A. Bevans: *A Technique for Radiographing the Organs of Speech during Articulation*; in *Zeitschrift für Experimental-Phonetik* 1.2.1-21 (1931). This includes a bibliography of this subject to the year 1929 inclusive.
- Parmenter, C. E., and C. A. Bevans: *Analysis of Speech Radiographs*; in *American Speech* 8.3.44-56 (1933).
- Russell, G. Oscar: *Speech and Voice, with X-rays of English, French, German, Italian, Spanish, Soprano, Tenor and Baritone Subjects*; New York, 1931.
- Russell, G. Oscar: *The Vowel, its Physiological Mechanism as Shown by X-ray*; Columbus, Ohio, 1928.

C. Palatograms and the Artificial Palate

- Balassa, J.: *Phonetik der Ungarischen Sprache*; in *Internationale Zeitschrift für allgemeine Sprachwissenschaft* 4.130-57 (1889).

- Chlumsky, J.: La Photographie des Articulations dessinées au Palais artificiel; in *Revue de Phonétique* 4.46-58 (1914).
- Durand, Marguerite: Étude sur les Phonèmes postérieurs dans une Articulation parisienne; in *Revue de Phonétique* 6.214-56 (1929).
- Emmett, E.: *Phonetic Studies with the Artificial Palate*; unpublished master's dissertation, University of Chicago, 1931.
- Kingsley, N. W.: Illustrations of the Articulations of the Tongue; in *Internationale Zeitschrift für allgemeine Sprachwissenschaft* 3.225-48 (1887).
- Laclothe, F.: L'Harmonie vocalique; in *La Parole* 9.177-88 (1899).
- Montalbetti, R.: Notes sur l'emploi de l'ouranine pour les palais artificiels; in *La Parole* 13.425-7 (1903).
- Rousselot, Abbé J.: Études de prononciations parisiennes, les articulations étudiées à l'aide du palais artificiel; in *La Parole* 9.481-2 (1899).
- Scripture, E. W.: Quelques perfectionnements apportés à la construction des palais artificiels; in *La Parole* 1903, 421-4.
- Varney, Jeanne M.: *Études sur l'L américain*; Paris, 1933.

HISTORICAL PHONETICS

- Aiken, J. R.: *Why English Sounds Change*; New York, 1929.
- Bauche, Henri: *Le Langage populaire, Grammaire, Syntaxe et Dictionnaire du Français tel qu'on le parle dans le peuple de Paris avec tous les termes d'argot usuel*²; Paris, 1928.
- Bloch, O., et W. von Wartburg: *Dictionnaire étymologique de la Langue française*; Paris, 1932.
- Bourciez, Edouard.: *Éléments de Linguistique romane*²; Paris, 1923.
- Bourciez, Edouard.: *Précis historique de Phonétique française*⁶; Paris, 1926.
- Brunot, F., et Ch. Bruneau: *Précis de Grammaire historique de la Langue française*; Paris, 1933.
- Dunn, Joseph: *A Grammar of the Portuguese Language*; Washington, 1928.
- Grammont, Maurice: *La Dissimilation consonantique dans les Langues romanes*; Dijon, 1895.
- Grandgent, C. H.: *From Latin to Italian, an historical outline of the phonology and morphology of the Italian Language*; Cambridge, Mass., 1927.
- Grandgent, C. H.: *Introduction to Vulgar Latin*; New York, 1907.
- Grandgent, C. H.: *Introducción al latín vulgar, traducción del inglés, adicionada por el autor, corregida y aumentada con notas, prólogo y una antología por Francisco de B. Moll*; Madrid, 1928.

- Jones, Daniel: *An Outline of English Phonetics*⁴; New York, 1934.
- Joran, Th.: *Péril de la Syntaxe et la Crise de l'Orthographe*; Paris, A. Savaète, undated.
- Kent, Roland G.: *The Sounds of Latin, a descriptive and historical phonology*; Language Monograph No. 12 of the Linguistic Society of America, Baltimore, 1932.
- Lenz, Rudolph: *Zur Physiologie und Geschichte der Palatalen*; Gütersloh, 1887.
- Marchot, Paul: *Petite Phonétique du Français pré littéraire (VI^e-X^e siècles)*; Fribourg, Suisse, 1901.
- Menéndez Pidal, Ramón: *Manual de gramática histórica española*⁵; Madrid, 1925.
- Menéndez Pidal, Ramón: *Orígenes del español, estado lingüístico de la península ibérica hasta el siglo XI*; Madrid, 1926.
- Meillet, Antoine: *Introduction à l'étude comparative des langues indo-européennes*⁷; Paris, 1934.
- Meyer-Lübke, Wilhelm: *Einführung in das Studium der romanischen Sprachwissenschaft*³; Heidelberg, 1920.
- Meyer-Lübke, Wilhelm: *Grammaire des langues romanes, traduction française par E. Rabiet*; Paris, 1890-1902.
- Meyer-Lübke, Wilhelm: *Romanisches Etymologisches Wörterbuch*³; Heidelberg, 1935.
- Navarro-Tomás, T.: *Manual de Pronunciación española*⁴; Madrid, 1932.
- Nyrop, Kr.: *Grammaire historique de la Langue française*³, 4 vols.; Copenhagen, 1914.
- Passy, Paul: *Étude sur les Changements phonétiques et leurs Caractères généraux* (Thèse, Faculté des Lettres, Paris); Paris, 1890.
- Passy, Paul: *L'Évolution de quelques Diftongues en vieux Français (sic) ei (oi), ie, ou (eu), uo (ue)*; in *Philologie et Linguistique, Mélanges offerts à Louis Havet* 341-58; Paris, 1909.
- Passy, Paul: *Petite Phonétique comparée des principales Langues européennes*²; Leipzig-Berlin, 1912.
- Pope, M. K.: *From Latin to Modern French*; Manchester, 1934.
- Richter, Elise: *Beiträge zur Geschichte der Romanismen, I. Chronologische Phonetik des Französischen bis zum Ende des 8. Jahrhunderts*; Halle-Saale, 1934.
- Rousselot, J., et F. Lăclotte: *Précis de Prononciation française*; Paris, 1927.
- Schuchardt, Hugo: *Der Vokalismus des Vulgärlateins*, 3 vols.; Leipzig, 1866-9.

Seelmann, Emil: Die Aussprache des Latein nach physiologisch-historischen Grundsätzen; Heilbronn, 1885.

Sturtevant, E. H.: The Pronunciation of Greek and Latin, the sounds and accents; Chicago, 1920.

Voile, Abbé G.: Les Origines des Complications orthographiques; in *Le français moderne* 2.1.57-69 (1934).

